POWER PLANT ENGINEERING

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Steam Generating Equipment of Mark Plant

IN THIS NEW PLANT OF THE STEEL & TUBE CO. OF AMERICA THE COAL AND ASHES HANDLING METHODS, COMBINATION GAS AND COAL FURNACES, FIRING METHODS, AND INDIVIDUAL STACKS ARE SOME OF THE INTERESTING FEATURES. BY GORDON FOX AND F. E. GRENLEY

MARK PLANT, of The Steel & Tube Co. of America, is located in the southern industrial district of Chicago, on the shores of Lake Michigan, at Indiana Harbor. The plant includes one blast furnace, a pig casting department, an open hearth department blooming, billet, plate and skelp mills and pipe welding and finishing departments. These mills are electrically driven throughout, only a small amount of steam being used in the various processes. There are no steam drives outside of the main power house. Electrical power is generated in the company's own station which feeds, in addition, the coke producing plant of the By-Products Coke Corporation, and adjacent property.

The power plant is a steam station comprising separate buildings for the boiler house and power house. The boiler house building is 302 ft. long and 55 ft. wide, of steel construction. The side walls are of expanded metal coated with cement plaster, forming a 2¼-in. wall. A

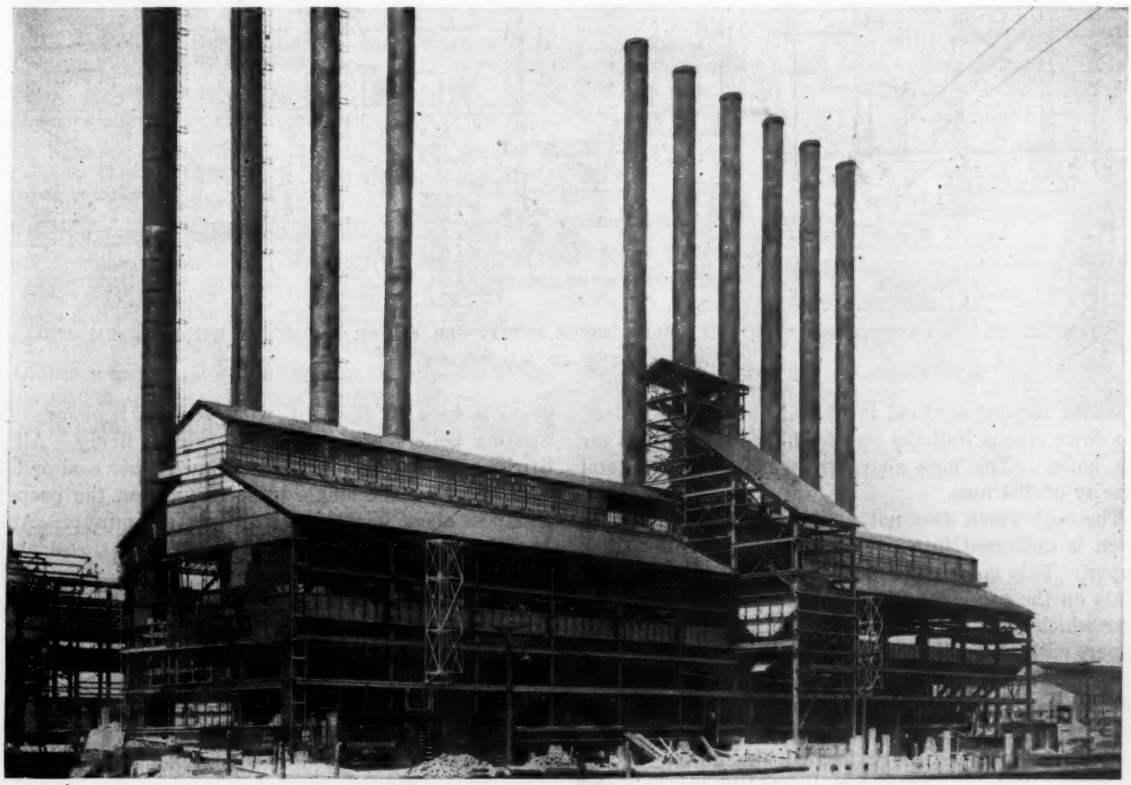


FIG. 1. VIEW OF BOILER HOUSE OF THE MARK PLANT DURING CONSTRUCTION

generous window area is provided with Fenestra steel sash. The roof is of flat cement tile with three ply asbestos covering. The central portion of the building is occupied by the coal handling equipment, the feed water heaters and boiler feed pumps.

Coal Handling System

Coal is delivered to the plant by rail in bottom dump cars which are emptied into a hopper below yard level situated in a lean-to adjacent to the central bays of the boiler house. It is carried into the basement by a feed conveyor to a four-roll crusher. The crushed coal is carried by an apron conveyor to a vertical bucket elevator which deposits it upon a revolving screen on top of a 90 ft. tower. The fine coal from this screen is delivered by chutes to flight conveyors on each side of the elevator. The flight conveyors, one serving each group

Steam Generators

Present steaming equipment comprises two groups, of six boilers each, located on either side of the central coal handling bays of the boiler house. One of these groups includes six Casey & Hedges vertical water tube boilers of 600 hp. capacity each. Each one of these boilers has three combined steam and water drums and three mud drums. A Foster superheater is installed in the first pass of each boiler.

The second group of six boilers are Stirling vertical water tube class "M" units of 600 hp. rating. Each boiler has 6000 sq. ft. of heating surface and an effective grate area of 126 sq. ft. The steam pressure of the plant is 200 lb. with 125 deg. F. of superheat.

All six of the Casey & Hedges boilers and four of the Stirling boilers are provided with Continental chain

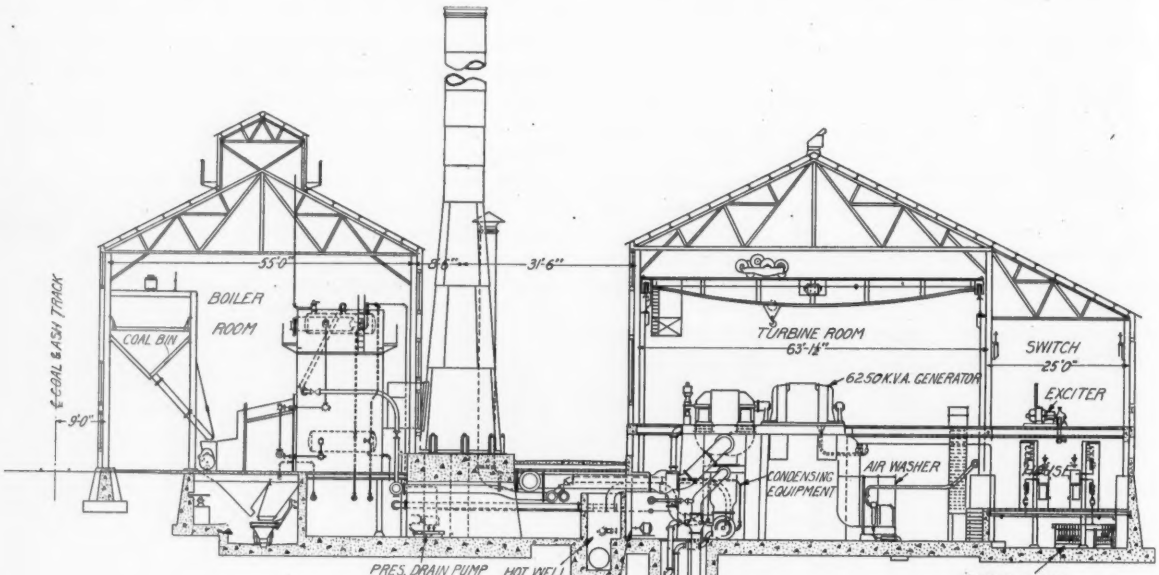


FIG. 2. TRANSVERSE SECTION THROUGH BOILER HOUSE AND POWER HOUSE, SHOWING PIPING SYSTEM AND ARRANGEMENT OF MACHINERY

of boilers, deposit the coal in the bins above the boilers. Two down spouts lead the coal to the stoker hoppers for each boiler. The bins above the boilers have a total capacity of 893 tons.

The coal which does not pass through the revolving screen is delivered into a bin directly above the track hopper. This coal is used in the three gas producer plants on the property. This coal may be dumped into a car which has been previously emptied into the track hopper, without moving the car.

Under each stoker is located one bin for fine coal and one for ashes. These empty into an electrically operated car of 60 cu. ft. capacity which conveys the ashes to a small tower with skip hoist located outside one end of the boiler house. The ashes are elevated by this skip and dumped into cars.

grate stokers 10 ft. 6 in. wide and 12 ft. long. Two Stirling boilers are arranged for hand firing. All six Stirling boilers are equipped to burn either coal or blast furnace gas. The single blast furnace on the property produces about 55,000 cu. ft. of gas per minute. About 16,000 cu. ft. per minute is used in the stoves at the blast furnace for preheating the air blast. The balance is fired under the boilers. The gas is cleaned at the blast furnace and delivered to the boiler house through an aerial gas line. The boiler house is located adjacent to the blast furnace district. The gas pressure at the boiler house varies from 6 in. to 50 in. of water, according to the working of the furnace. The heat value of this gas is about 90 B.t.u. Each Stirling boiler is provided with four 10-in. gas burners located above the grates and directed into the combustion chamber. In these burners

the gas flows in the center and forms a whirling action. The air is drawn in by suction and thoroughly mixed with the gas before combustion takes place. The gas burners are arranged with adjustable openings. A steel platform about 8½ ft. above the operating floor running along the front of the boilers permits easy access to these burners. On account of the varying pressure of the gas, the air openings require frequent adjustment.

Firing Methods

At the end of each cast at the blast furnace the blast is shut off for a short period and no gas is available for the boilers. Casts are made six times daily, each shut down lasting about 5 min. During these periods it is necessary to burn coal under all boilers in service. While gas is being burned a banked fire is carried on the grates, there being little draft through this fire because of the pressure in the combustion chamber due to the gas burner blast. About 30 min. before a cast the boiler house is notified. The stokers are started at slow speed with a 5-in. bed. By the time the gas goes off, this coal is incandescent from the blast and is able to take up the load. Coal is then burned until gas is again available.

The six stokers for each group of boilers are group driven from a shaft in the basement. This shaft is driven by a constant speed induction motor through a clutch and gear reductions. A duplicate motor and control is provided, the load being transferred from one motor to the other by the clutch.

Each of the twelve boilers in the plant is provided with an individual self supporting steel stack 200 ft. high. The stacks are lined with fire brick the entire distance. The inside diameter is 7½ ft. Six stacks are carried on one foundation which is supported by Raymond concrete piles. When the boilers are worked at 175 per cent rating the draft over the fire is 0.20 in. and 1 in. in the stack breeching.

Each boiler has automatic damper and stoker regulation operated from a master control connection to the steam main. Water pressure is used to operate the dampers and adjust the stoker speed. A red light signal shows when the dampers are open.

Galleries extend along and around the superstructure of the boilers with stairs at each end and at the center of the building. All openings and hand holes are thus made accessible without the use of ladders.

Boiler Mountings

Williams new type feed water regulators, Reliance high and low water alarm columns, Marsh steam gages, Consolidated safety valves, Foster non-return valves and Cadman blowoff valves are some of the equipment for each boiler. There is a separate blowoff system for the water backs as they also act as circulating agents under boiler pressure. One blowoff system is provided for six boilers. Boilers and water backs are blown every 6 hr.; boiler tubes are blown daily; boilers are washed and turbined every 45 days. Recording steam flow meters, stack and steam temperature thermometers and draft gages are located at each boiler. In the boiler house superintendent's office are located a venturi meter, steam gage and feed water temperature gage. The present load on the boiler plant ranges from 6500 to 8000 boiler horsepower, the steel plant being not yet in complete operation. This load is carried by eight or nine boilers, one unit being kept in reserve. Each boiler carries a load of 750 to 1000 boiler horsepower, this load being rather fluctuating in nature. The coal fired boilers are

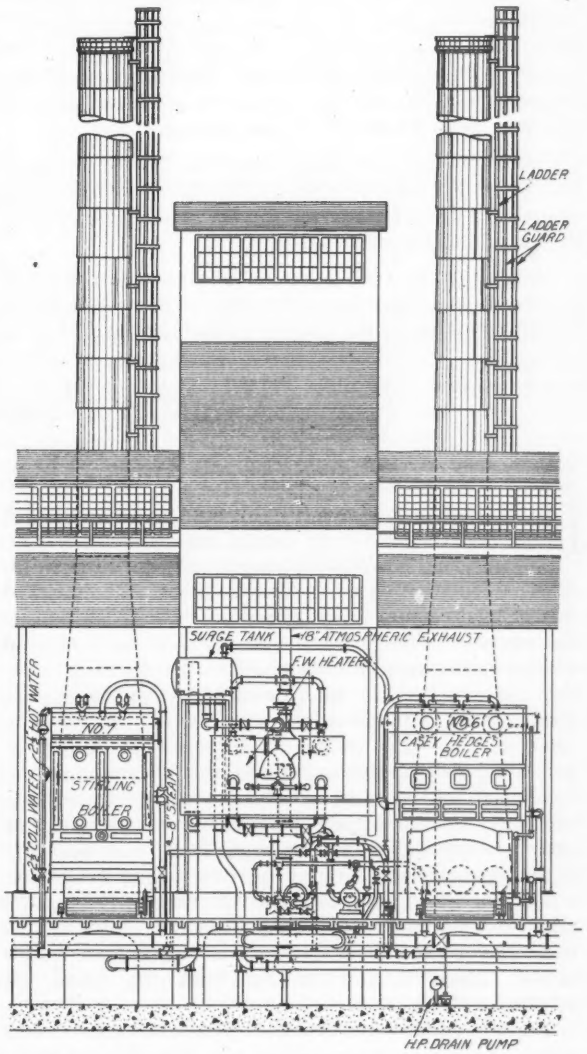


FIG. 3. PARTIAL LONGITUDINAL SECTION OF BOILER HOUSE, SHOWING FEED WATER HANDLING SYSTEM

expected to handle 175 per cent rating and the gas fired boilers 150 per cent rating.

Feed Water and Piping Systems

Two hot wells are located in the basement under the aisle between boiler house and power house. Boiler feed water is pumped from the hot well by one of two motor driven Cameron centrifugal pumps of 1000 g.p.m. capacity and delivered to two 8000-hp. Cochrane heaters located in the central bays of the boiler house. The

heaters are used singly. The exhaust steam from the various condenser auxiliaries and pumps, operating at ½ lb. back pressure, suffices to bring the feed water to 212 deg. F. The piping is so arranged that water may be taken from the plant service stand pipe either to the heaters or boiler feed pumps direct.

Water is pumped to the boilers by any one of three turbine driven three-stage centrifugal pumps of 700 g.p.m. capacity. The pump speed is regulated by governors and the pressure is maintained at approximately 15 lb. above boiler pressure. The boiler feed pumps are located in the central bay on the operating floor of the boiler house. The feed water heaters are installed on a platform about 14 ft. above these pumps.

There are two feed water lines, one line in conjunction with the feed water regulators, the other line being equipped with hand control valves. The latter is used in case of trouble with the former.

All piping between boiler house and power house is located in the basement under the aisle between these buildings. The piping being confined to this space as much as possible leaves both boiler house and power house comparatively clear. It also makes the piping system accessible. An 18-in. steam header extends along the boiler house side of this basement. Another 18-in. header extends along the power house side. Three 12-in. connecting pipes are supplied. Valves are so arranged that the power house may be supplied from any group of three boilers or a multiple thereof, with the rest of the header shut off. Feed pipes to the various turbines are provided with up flow receiver separators. All high pressure piping is extra heavy with steel fittings and Van Stone joints 2½-in. and over. All valves are suitable for superheated steam and those 8 in. and over are by passed. All live steam piping is covered with two thicknesses of J.M. 85 per cent magnesia covering. Exhaust piping is equipped with a single thickness of the same material. Water pipes are covered with one thickness of wool felt covered with canvas. All piping has been so arranged that future units may be connected with the present installation intact.

Features of the power house and electrical distribution system will be described in another issue.

Wasting Power in the Using

TRANSMISSION LOSSES, WASTE OF POWER AT MACHINES AND METHODS SUGGESTED FOR OVERCOMING THEM. BY L. W. ALWYN-SCHMIDT

POWER is wasted not only by faulty production but just as frequently by faulty transmission or consumption. Wasteful habits of the factory hands, inefficient construction of the transmission rods and gear will bring to naught any policy of power conservation inaugurated in the power house, and the small savings which can be made by keeping a severe check on production methods are lost again because the factory equipment cannot be brought into line with the general efficiency scheme. The trouble in all these cases is that the individual loss of power, wherever it occurs, is so infinitesimal that it is easily overlooked. In their total, however, they make quite a considerable loss of energy and when checked the results begin to show immediately in the power house. Now when power saving has become a national duty, engineers and efficiency experts have given more attention to this question of power loss in transmission, and a more careful study is made of its causes. Even so, however, our knowledge is all but conclusive.

There is a lack of co-operation between the men using power and those producing it and generally speaking not enough authority is given to the power house engineers in the handling of the distribution and consumption side. As a result, many of our power engineers lack experience in dealing with that important problem and having received only too often scant thanks for their trouble are not likely to make suggestions even if they are able to do so. Also our efficiency engineers have shown little initiative in this direction. While untold articles have been written by these gentlemen about general efficiency in power production, there is hardly anything done by them to enlighten the factory owner and the power engineer about the principles governing power consumption; so all have to find out for themselves.

Under ordinary circumstances, the problem of power waste as a rule turns up under the heading of machine trouble. One of the machines does not work well and it is then found that something is the matter with the transmission, the lubrication or the pulleys. The fault is corrected and the machine runs again at its normal efficiency. Incidentally also a power leak is stopped. Only nobody has given attention to this side of the trouble.

The question of power wastage, therefore, is approached in nearly all instances from the wrong end. It is the case of a doctor who eliminates the outward effects of a cold by applying snuff to the nose of the patient without attacking the disease of the human system. It should never be forgotten, that machine trouble in a great number of cases is not incidental to one machine only, but is caused very often by a defect in the whole system. An attempt to cure it should be approached from the power house leading step by step over the whole transmission system to the consumption end of the line.

Waste of power may occur during transmission by (1) faulty construction of the primary and overhead transmission system, (2) lack of maintenance or insufficient maintenance methods, (3) overhead pulleys, (4) transmission belts, (5) wrong alinement of machines and pulleys, (6) machine pulley, (7) machine lubrication, (8) machine efficiency. These are the primary causes. As secondary causes leading to power waste must be mentioned (1) faulty handling of transmission gear by machine tender, (2) careless habits of machine hands. There are a good many subdivisions to each of these principal divisions and the list is not complete by far.

Faulty Construction

Faulty construction of the principal and overhead transmission system of the factory of course is the most serious cause of power waste, as it can be repaired only with great difficulty after the installation is once made. If power has to be carried by transmission belts a long distance from the power house, part of it of course will be lost in transmission. The only thing that can be done in such a case is to minimize that loss as much as possible by keeping the belts in perfect order and supporting them wherever necessary by idlers. Keep the belts as loose as possible and guard against deterioration by protecting the transmission system from the influences of the climate.

Faulty construction of the principal transmission and overhead system is very difficult to detect. To discover it is with some engineers more a matter of intuition than of actual knowledge, and if asked, they do not seem to be able to determine exactly the reason for their opinion. With the extension of technical research, soon a set of rules will be available, easily applied, which will make impossible the most outstanding causes of power waste in the primary part of the transmission system, and we then shall find, most likely, that most of the transmission systems used in our factories are constructed on uneconomic lines. In the meantime, everything that is done to the transmission system to secure its safe and permanent operation also will tend to decrease the waste of power.

Maintenance

There are no hard and fast rules as to the division of labor connected with the maintenance of the power transmission system. In some cases the power house staff will not do any maintenance work at all, in others the power house will care for the production end and the transmission line as far as it reaches to the factory, while the millwrights and factory oilers are taking care of the inside maintenance. The latter as a rule are not controlled by the power house engineer, but are under the direct supervision of the millwright or foreman. It is their duty to clean the overhead transmission lines, lubricate the points of friction and take care of them generally. As they have to do also the oiling of the machines in the shop, these oilers are pretty busy. A sufficient number of them should be provided, they should be conscientious men, and they should be carefully trained as to their particular work. Skipping important points is one of their faults, and the habit, if repeated, may lead to considerable losses in power efficiency, quite apart from the danger to the machines. To secure the prompt attention of the oilers to the overhead transmission system, this should be included in their general routine work as a job which has to be repeated in regular intervals. If there is sufficient work, one man should be in permanent charge of the overhead system.

In most factories the job of the oiler is regarded as requiring only unskilled labor. In others the position as oiler may be the first step in the direction of engineer. The work is really very important and should be put into the hand of a high class man with a knowledge of what he is doing. There is a great deal of preservation work to be done in the overhead transmission system in the interest of good maintenance and power conservation, and the man in charge of it should be capable to detect faults when they occur.

Overhead Pulleys

Overhead pulleys should not become loose, but nevertheless they will do so, and one faulty pulley very soon will affect the whole shaft. Loss of power from this source may not be very heavy in the beginning, but it has a habit of accumulating as the trouble spreads, and it is necessary that it should be remedied immediately when discovered. Hence the necessity of having responsible men on the job. It is desirable that this work also is overseen by the power house staff as they are the men who are most interested in the question of transmission and on whom falls first the blame for any irregularity.

Transmission Belts

Taking for granted a perfect primary transmission and overhead system well kept and working efficiently, the next place where trouble will occur is the belt lines from the overhead pulleys to the machine pulleys. Engineers and shop overseers could write books on the question of power conservation if they only could be made to write down their experiences. The principal cause of trouble are slipping belts. Ask the man on the machine why the belt slips and he will have a series of explanations, none of which is convincing. It is a peculiar fact that belts will slip just as easily when they are too loose and when they are too tight, they will slip under all kinds of conditions, but whenever they slip there is loss of power efficiency. All kinds of belt dressings have been recommended by various writers, starting with lime and ending with the most complicated compounds, but a "spiteful" belt will slip, dressing or no dressing. Often turning of the belt will remedy the defect. The general rule to be followed is to place the grain side of the belt next to the pulley and not the flesh side. This does not look quite so nice, but it is decidedly more practical and often will stop slipping altogether. A good deal of slipping is caused by stretching. The belt in this case should be shortened. If a single belt will not do the job, a double belt must be fitted. As a rule for all heavy work double belts should be employed, which, if made a practice all over the factory, will soon show in the power bills. The oilers and cleaners should be instructed to keep the pulley surfaces clean and should be cautioned not to use sticky belt dressings. The whole problem of power conservation on this point of the transmission line centers on how to obtain best grip of the belts on the pulleys with as little actual friction as possible. But the grip of the belt on the pulley must be strong enough to allow the smooth starting of the machines. Idlers installed in support of long vertical belt lines will prove of great value and will largely reduce the strain.

Poor Alinement

Poor alinement of shafting and pulleys is another cause of power waste which, however, cannot always be completely eliminated, especially under the present very

crowded condition in many of our factories. The mistake frequently is already made when the shafting and pulleys are fixed. It may, however, also develop in a later state, especially in the case of light machines which have not been properly fixed to the floor. The results of poor alinement are slipping belts, loss of machine efficiency and loss of power development. If loss of power is suspected in a factory, the question of alinement should be studied most thoroughly, and faults, if existing, should be corrected. What has been said with reference to pulleys in connection with overhead equipment also refers of course to the machine pulleys.

Lubrication

Strictly speaking, the responsibility of the power house ends when the power is delivered to the machines. As the lubrication of the indoor transmission system, however, is done as a rule also by the same men who attend to the oiling of the machines the question of machine efficiency in its effect on power consumption may be considered too. A well oiled and well kept machine will need less power than a machine of the same type which is badly oiled and kept. There are in each factory machines which seem to require more power than others of the same type. Only it is very difficult to lay one's hand immediately on the cause of the trouble. When testing machines as to their corresponding power requirements, always the best machine should be used as the standard, and an attempt should be made to bring the others up to the higher average. How this standard can be established depends, of course, a good deal on the kind of machine in use. In the case of light machines, it has been suggested to cut off the power and let the machine run empty until it comes to a standstill. The number of revolutions made by the flywheel in this case would determine the efficiency of the machine. This test, however, cannot be made in every case, and it is really up to every engineer to evolve his own standard and method of testing.

Which brings to an end the review of the causes of loss of power by imperfect transmission methods. In the interest of power conservation an occasional inspection of the transmission equipment with special reference to these points should be made by the engineers in each plant. The inspection must be thorough until the engineers are satisfied that the equipment works as perfectly as can be.

Machine Efficiency

But the most perfect tuning up and supervision of the power production and transmission equipment cannot stop that part of the power loss which is caused by the men handling the machines. Wasting power in the using is the principal form of power leakage with which the power engineers are confronted in their campaign of conserving power and coal. Unfortunately it is also the most difficult form of power wastage to deal with. The transmission of power from the boilers to the machines is a matter of equipment efficiency. There is such a thing in this world as the perfidy of the object, and a power equipment may have its idiosyncrasies, but it is nothing as compared with the idiosyncrasy of men. Pulleys will crack, belts will slip in the most unexpected moment, but there is as a rule a way to overcome the difficulty. Deal with men and for one idiosyncracy, there are a hundred; correct one faulty habit and the next day will show another. The principal difficulty in handling this side of the problem is that the men cannot see immediately the result of their careless action. A machine left running idle does not mean to the mind of the man behind the machine a loss of power efficiency to be expressed in pounds of steam, it even may represent to him a convenience. It is further often the question whether it really pays from the point of view of power conservation to shut off a machine for only a short while to restart it again, as the energy used in restarting may fully absorb the saving made by stopping. To lay down a hard and fast rule in which cases the machines should be stopped and when not is practically impossible. It may be done in a factory where a great number of similar machines are in action, as for instance in a shoe factory or a tool factory; but in the great majority of cases it would be more or less out of the question to give any direction. And, if it would be given, it is impossible to see how it can be enforced.

As it is, there is already now a disinclination of foremen to pull up their men too often. It does not lead to much good and the result will be discontent amongst the men which may direct itself against the person of the foreman. No doubt the factory hands themselves can do a good deal in support of power conservation in any factory and their help should be enlisted for that purpose. As pointed out already there are two principal causes why power is wasted by the hands, of which the first is the faulty handling of the transmission gear, which includes faulty starting and disconnecting the machine, wrong use of the brakes, if such should form part of the equipment, and many other careless habits which will develop even in the best organized force. Secondly there is the idle running of machines.

The losses occurring from all these sources are very heavy, but it is difficult to tabulate them in a proper manner. To eliminate their causes and to correct the faulty habits of which they are the result needs a great deal of tact and energy. The staff manager seems to be the proper person to appeal to. He is the man who is best known to the hands and it is his duty to take care of the interests of the management with the employes. Being not in direct charge of the shops and more or less an outsider, he will be most easily listened to by all concerned and his co-operation is most valuable. He can lay the case before the men. He can explain to them the necessity of discontinuing habits leading to heavy losses in the power efficiency of the plant and ask for the co-operation of the men. There are many examples of campaigns carried on in factories for the purpose of stopping power leaks caused by the faulty or negligent handling of machinery. One has been described by the writer in this magazine.

Supervision when it is resorted to must be of such a kind as not to become oppressive to the men. It must direct rather than order and it must lead to a correction of the faulty habit. It, therefore, must be educational. Notices posted in the workroom as a rule have only a very temporary result. They are easily overlooked, as

the experience shows in the case of the safety caution notices distributed by the Department of Labor. To overcome this difficulty it has been recommended to change the wording of the notices frequently and also to change the color of the paper or cardboard on which they are printed. Illustrations are a very useful help in a campaign of this character and illustrated posters, especially those of a humorous character, are bringing good results. Always remember: do not correct too much.

The principal purpose of supervision must be prevention. Careless habits, especially those connected with power waste, spread. If observed, they should be checked immediately and the situation be explained to the offending hand. This will do more than any campaigning after the event. Fifty per cent of all power waste caused by the careless habits of the men would not take place if its cause had been discovered at the start by the foremen or the millwrights.

Fuel Economy in Hand-Fired Power Plants---V*

Feed Water Heating and Purification

THE majority of waters used for boiler feeding purposes contain more or less impurities which are deposited in the boiler. Such deposits of foreign matter tend to decrease the evaporative capacity of the boiler and, if they are not removed, will frequently cause overheating of tubes and sheets. To overcome these difficulties the impurities in the feed water should be removed before feeding into the boiler.

For convenience of reference, the impurities most often found in feed water and their effects upon the sheets and tubes if permitted to enter the boiler are given in columns 1 and 2 of the table. In the last column of this table are given the usual remedies employed to neutralize or to prevent to a certain degree the effects produced by the various impurities. Some of the impurities found in feed water cause the formation of scale on the sheets and tubes, others cause corrosion of the metal, and still others produce priming, or the carrying over of particles of water with the steam as the latter leaves the boiler.

One of the best ways of determining the remedy to be applied in overcoming the injurious effects of the impurities contained in the feed water is to submit a sample of the water to a reliable chemist for analysis and prescription. After such an analysis has been made, it is possible to ascertain which one of the following treatments should be applied: chemical treatment, heat treatment, or combined heat and chemical treatment.

Chemical Treatment

CHEMICAL TREATMENT of feed water involves the use of either the lime or the soda process or a combination of these two. The first of these processes in which slacked lime is used is well adapted for precipitating the bicarbonate of lime and magnesia contained in the feed water. In the soda process carbonate of soda or caustic soda, either separately or together, is used for converting the sulphates of lime and magnesia into carbonates or chlorides which may be disposed of by occasional blowing off. The combination of the lime and soda processes, however, is most frequently used. It is satisfactory for treating water containing sulphates of lime and magnesia, carbonic acid, or bicarbonates of lime and magnesia. In this process the sulphates are broken down by the use of sufficient soda, and the necessary lime is added to absorb the carbonic acid not taken up in the soda reaction.

Heat Treatment

THE BICARBONATE of lime and magnesia so often found in natural waters may be partially precipitated by preheating the feed water in some form of apparatus commonly called a heater. The sulphates of lime and magnesia, however, require high temperatures for complete precipitation and it is impossible to remove these impurities by the simple process of preheating in the ordinary heater using exhaust steam. Instead, live steam heaters and economizers are required for removing them.

Combined Chemical and Heat Treatment

SINCE PREHEATING of feed water removes the carbonates of lime and magnesia, many water purification systems combine the chemical and heat treatments discussed in the preceding paragraphs, the chemical treatment being used merely for reducing the sulphates.

IMPURITIES IN FEED WATERS, THEIR EFFECTS AND REMEDIES[1]

Impurities	Effects	Remedies
1	2	3
Sediment, mud, clay, etc.	Incrustation and the formation of sludge	Settling tanks, filtration, blowing down.
Bicarbonates of lime, magnesia		Blow down.
Sulphates of lime and magnesia		Heat feed water. Treat by adding lime.
		Treat by adding soda. Barium carbonate.
Chloride and sulphate of magnesia	Corrosion	Treat by adding carbonate of soda.
Acid		Soda or lime.
Dissolved carbonic acid and oxygen		Heat feed water. Keep air from feed water. Add caustic soda or slacked lime.
Grease		Filter. Iron alum as coagulant. Neutralize with carbonate of soda. Use the best of hydrocarbon oils.
Organic matter		Filter. Use coagulant.
Sewage	Priming	Settling tanks. Filter in connection with coagulant.
Readily soluble salts in large quantities		Blow down.
Carbonate of soda in large quantities[2]		Barium carbonate. New feed supply. If from over treatment, change or modify.

[1] "Steam," published by Babcock & Wilcox Company.
[2] May cause brittleness in plates. See Bulletin 94, Eng. Exp. Sta. Univ. of Ill., "The Embrittling Action of Sodium Hydroxide on Soft Steel," by S. W. Parr.

Boiler Compounds

SO-CALLED BOILER COMPOUNDS are used rather extensively for treating feed water and no doubt in many cases the results obtained are satisfactory. According to reliable authorities the use of compounds is recommended for the prevention of new scale rather than for the removal of old scale. In general, no compound should be used until the proper advice has been obtained to insure the selection of the right compound for the particular feed water to be treated. In no event

* Abstract of Circular No. 7, entitled Fuel Economy in the Operation of Hand-Fired Boiler Plant, published by the University of Illinois Engineering Experiment Station.

should the use of boiler compounds be regarded as a suitable substitute for regular cleaning and inspection.

Feed Water Heaters

In any power plant of considerable size cold water should not be fed into the boilers, since all steam boilers are more or less seriously affected by the resulting unequal expansion and contraction. If cold water is forced into the boiler, the tubes of water-tube boilers are very likely to become troublesome while in return tubular boilers the seams are liable to develop leaks. Furthermore the feed water cannot be converted into steam until its temperature is raised to the point controlled by the steam pressure, and to do that requires fuel. If the temperature of the feed water can be raised by means of heat which otherwise would be wasted, it is good economy to do so. The preheating of feed water also increases the steaming capacity of the boiler, because of the reduction in the amount of heat to be supplied by the boiler per pound of water evaporated. With certain types of feed-water heaters a considerable portion of the scale forming ingredients are precipitated before the water enters the boiler, thus increasing the efficiency and capacity of the boiler as well as effecting a saving in the expense of cleaning out the boiler. In general, it may be stated that one per cent of fuel is saved for every 11 deg. F. rise in the feed water temperature, provided the heat producing this rise in temperature would otherwise be wasted.

In steam power plants there are two main sources of waste heat, the first being the exhaust steam of the various units, and the second the products of combustion which pass from the boiler to the chimney. The heat contained in the drips from the high-pressure piping system is also a source of loss in many small plants, although its extent is not great. Condensation in the high pressure system, which includes all piping under pressure practically equivalent to boiler pressure, is free from oil and should be returned to the feed-water heater by means of pumps or traps. If desired the condensed steam may be returned directly to the boiler. In steam power plants, high-pressure steam traps are generally used for automatically draining the condensation from the high pressure lines.

Exhaust Steam Heaters

Heaters using exhaust steam for heating the water may be either of the open or closed type.

An open heater is one in which the exhaust steam and water mingle, the steam in condensing giving up its heat directly to the water. In general an open heater consists of a shell the upper part of which contains a number of removable trays. The function of these trays is to break up the incoming feed water into thin streams or layers. In passing over the trays, the water mingles with the exhaust steam, and if sufficient steam is supplied temperatures as high as 210 deg. F. may result. It is evident that in an open heater only those scale forming ingredients which will precipitate below 210 deg. F. will be deposited in the heater. Below the trays, the heater is provided with a bed of coke or charcoal through which the water is filtered before the feed pump sends it into the boiler. The function of the coke or charcoal filter is to remove the precipitates and other suspended impurities coming into the heater. Open heaters should always be supplied with a suitable oil separator for removing any oil contained in the exhaust steam.

Closed Heaters

In a closed heater the exhaust steam and feed water do not come into actual contact with each other, the steam giving up its heat to the water by conduction. In one type of closed heater the exhaust steam surrounds tubes through which the water passes. In a second type, the steam passes through tubes which are surrounded by the water. Closed heaters are recommended only for installations where the feed water is free from scale forming ingredients, since there is a tendency for the tubes in these heaters to become coated with a deposit of scale, thus materially decreasing the efficiency of the apparatus.

The advantages of an open heater are as follows:

(1) The feed water may reach approximately the temperature of the exhaust steam provided sufficient steam is supplied.

(2) Scale and oil do not affect the transmission of heat.

(3) The pressure in an open heater is low, practically atmospheric.

(4) Scale and other impurities precipitated in the heater may easily be removed.

(5) An open heater is well adapted to heating systems in which it is desired to pipe the returns direct to the heater.

(6) The initial cost of an open heater is generally less than that of a closed heater.

(7) With the open heater all the condensed steam is returned to the system.

The disadvantages of an open heater are as follows:

(1) Some provision must be made for removing oil from the exhaust steam. In modern open heaters this is accomplished by effective oil separators attached directly to and forming a part of the heater.

(2) "Sticking" or clogging of the back pressure valve may subject the open heater to excessive pressure.

(3) If the feed water supply is under suction, open heaters may require the use of two pumps, one for hot and one for cold water.

The advantages of a closed heater are as follows:

(1) The closed heater will safely withstand any ordinary boiler pressure.

(2) Oil does not come in contact with the feed water.

(3) It is the only type of heater which may be used in the exhaust main between a prime mover and its condenser.

(4) Since it is customary to locate a closed heater on the pressure side of the feed pump, only one pump, and that for cold water, is necessary.

The disadvantages of a closed heater are as follows:

(1) Scale and oil deposits on the tubes lower the heat transmission.

(2) The temperature of the feed water will always be from four to eight degrees below the temperature of the incoming exhaust steam.

(3) Scale in the tubes is removed with difficulty.

Economizers

Economizer is an arrangement of vertical water tubes arranged in nests, located in the flue between the boiler and the stack. Its purpose is to heat the feed water. The adjacent nests of tubes are connected together by means of expansion bends. To prevent deposits of soot, the tubes are provided with automatic scrapers which are kept moving up and down by means of a suitable mechanism driven by a motor or a small steam engine. Since the temperature of the flue gases is generally about 550 deg. F., it is evident that considerable heat escapes through the chimney. In general, the load factor, the size of the plant, and the cost of fuel are factors which should be considered in determining the advisability of installing an economizer.

Live Steam Heaters

Live steam heaters use steam at boiler pressure and, as mentioned in a preceding paragraph, are primarily intended for purifying the feed water. Such heaters are generally not installed unless scale forming impurities are found in the water. At temperatures less than 300 deg. F. the sulphates of lime and magnesia do not entirely precipitate; hence a feed water containing these impurities will not be thoroughly purified by preheating with exhaust steam at atmospheric pressure. Reports of tests tend to show that live steam heaters do not increase boiler efficiency, but merely act as purifiers. Live steam heaters should always be by-passed and so located that the bottom of the shell is at least two feet above the water level in the boiler, thus permitting the purified water to gravitate into the boiler.

Feeding Boilers

Water is fed to the boiler by means of an injector or a pump, depending upon the size of the plant. The use of an injector does not permit preheating the feed water by means of an open heater; hence relatively cold water is introduced into the boiler, thus decreasing the economy of the plant. It is possible to install between the injector and the boiler a closed heater, but in such an installation the effectiveness of the heater is decreased because of the heat supplied by the injector. Frequently it is claimed that an injector considered as a combined pump and heater has an efficiency of 100 per cent since all the heat in the steam used for operating the injector is returned with the water forced into the boiler. Considered as a pump the injector is very inefficient since it requires much more steam to force a given amount of water into the boiler than is required by a pump to do the same amount of work. Furthermore when a pump is used for feeding boilers, the exhaust steam from the pump may be used for preheating the feed water. According to tests, a direct acting steam pump, feeding water through a heater in which the exhaust steam of the feed pump is utilized, shows a much greater saving of fuel than an ejector with or without a heater. In general the feed pump must be located below the water level in the heater, preferably about 3 ft. below, since hot water cannot be lifted by suction.

In order that it may be possible to check the efficiency of the boiler as well as that of the fireman or to determine the most economical fuel, the feed water system should include some form of metering device for measuring the water fed to the boilers. There are a number of metering devices on the market, some of which are permanently accurate and some of which must be checked up at frequent intervals. There are now several manufacturers of feed water heaters who are prepared to furnish heaters equipped with water measuring devices.

In addition to measuring the amount of water fed to a boiler, provision should be made for weighing the coal used by each boiler, thus affording a means of determining for each boiler the evaporation per pound of fuel. This will also make it possible to compare the performance of any two boilers in the plant.

For the majority of small boiler plants the feed water should be introduced into the boiler at a constant rate rather than intermittently as is too frequently done.

Flooded vs. Dry Ammonia Condenser

As a result of tests made on atmospheric, double-pipe, injector and shell condensers, run flooded and empty, Henry Torrance, in a paper before the A. S. R. E., presented the conclusion that the empty or dry method of operation, where liquid is removed as fast as formed is much the better.

Louis Block, in the discussion, combated this idea, but did not appear to convince his hearers. As a result, a test on a Block condenser is to be made in Boston to try to settle the question.

The war is over; peace reigns on earth. But in Europe today there are more than 2,000,000 American soldiers, who took an important part in bringing the war to a victorious end, and these men must be fed and clothed for a long while to come. It is estimated by the War Department that the cost of equipping and maintaining an American soldier in Europe is $423.27 a year.

The American army was transported to France at the rate of 250,000 men a month by giving them first call on the shipping facilities of the United States. If they could be brought back to their homes thus speedily—and it is doubtful that they could—it would require at least 8 mo. It is obvious, therefore, that we must continue to raise money with which to maintain our army abroad.

"We are going to have to finance peace for a while," said Secretary of the Treasury McAdoo, "just as we have had to finance war."

And that means that the American people, having supported four Liberty Loans with a patriotism which future historians will surely extol, are to be vouchsafed an opportunity to support our victorious peace. There will certainly be at least one more Government Loan. There probably will be two more—and possibly three. At any rate, the next loan must be prepared for and its success made certain. Get ready now to buy more bonds.

"A drop of petroleum is equal to a drop of blood," says a French senator. Think of this when you use it or its distillates as fuel or lubricant.

Steam Turbines for Natural Steam

POWER PLANT AT LARDERELLO, ITALY, OPERATING LARGE TURBINE UNITS WITH NATURAL STEAM TAKEN FROM CREVICES AND FISSURES IN THE GROUND

IN the region of Larderello, Italy, is a constant emission of steam and hot water from crevices and fissures in the ground. Elsewhere such phenomena have been looked upon merely as natural curiosities, but at Larderello the hot water was found to be highly charged with boric acid, which led to the commercial exploitation, the boric acid being extracted and sold. In order to increase the output, bore holes were sunk to supplement the natural flow, some of them being 16 in. diameter and from 200 to 500 ft. deep. The supply was thus largely augmented, and on closing in the top of some of the bore holes it was found that a steam pressure of about 45 lb. gage existed, which led to the idea of utilizing the steam for power production. The project appeared promising in that a continuous and ample supply seemed to be assured, since it was found that the large increase which had been made in the number of bore holes sunk had in no way diminished the flow from previously existing vents.

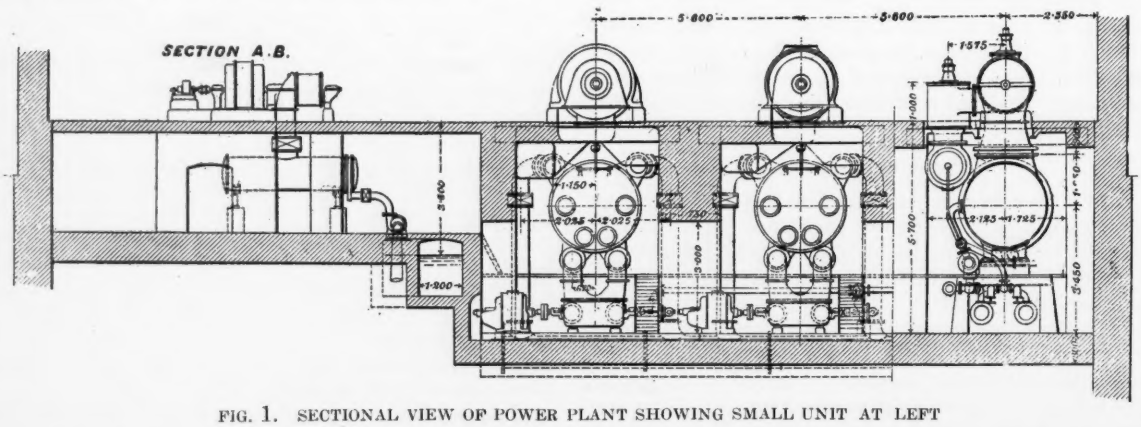


FIG. 1. SECTIONAL VIEW OF POWER PLANT SHOWING SMALL UNIT AT LEFT

A small reciprocating engine was installed in 1897,

FIG. 2. INTERIOR OF POWER HOUSE SHOWING UNITS IN PLACE

and a larger one in 1905. Both worked very satisfactorily, and it was evident that sufficient steam was available to operate a plant of considerable capacity. The available pressure, however, was low, with no flow the pressure reached 45 lb. gage, but decreased as the flow increased, and it was found that not more than 30 lb. gage could be depended on as the effective pressure. At the same time, as a bore hole is in the nature of things, very adequately lagged, the temperature of this steam, as delivered, was 180 deg. C., which is above the saturation temperature and would correspond to a pressure of about 145 lb. absolute were the steam saturated.

This condition of a supply of steam at low pressure and with a considerable superheat, is one which is better adapted to the steam turbine than to the reciprocating engine, but, on the other hand, the natural steam at Larderello is highly charged with CO_2 and other gases which would make it difficult to secure the high vacuum, lacking which the advantage of the turbine is materially discounted. Hence, when the first turbine, a 250-kw. unit, was installed in 1912, it was decided to use the natural steam merely as a heating agent, and by its aid to evaporate pure steam at a lower pressure and to use this pure steam in the turbine, which proved quite satisfactory so that it was decided to adhere to that plan, when installing the three 2500-kw. turbines which were put into service in 1916.

Each of the evaporators used to supply the pure steam, consist of a vertical steel drum, the headers of which are tube plates into which are expanded 300 aluminum tubes. These tubes are about 23 ft. long and 1.2 in. diameter. They were made of aluminum in order to resist the action of the sulphuric acid, of which a certain portion is found in the natural steam which flows outside the tubes; the water to be evaporated passes through the tubes, steam generated passing through a superheater before it enters the main steam range. The superheater is heated by the natural steam on its way to the evaporator. Pressure at which the pure steam is generated is about 15 lb. gage, but the turbines are designed to give their rated output with a gage pressure at the turbine of 2.75 lb. per sq. in.

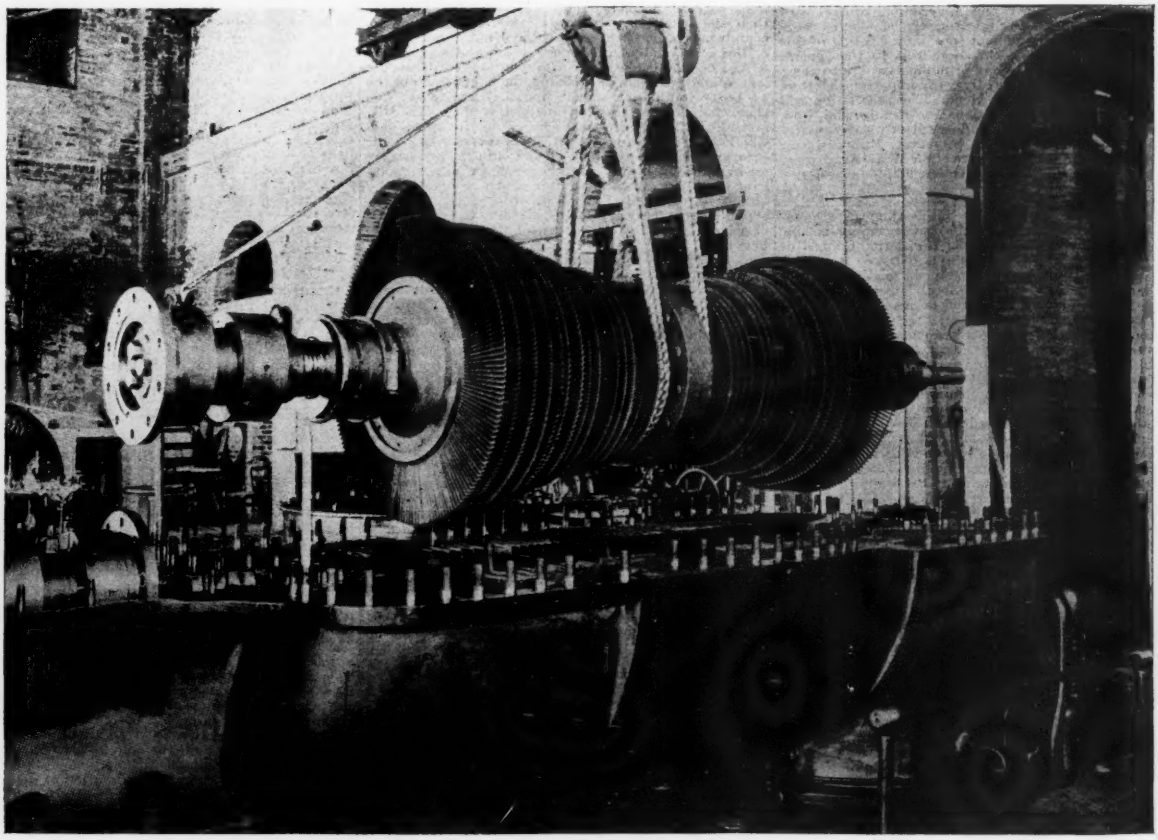


FIG. 3. ROTOR OF 2500-KW. TURBINE OUT OF LOWER HALF OF CASING

A sectional view of the turbine room is shown in Fig. 1. At the left is the 250-kw. unit erected in 1912, the three 2500-kw. units being at the right. These turbines run at 3000 r.p.m. and are coupled to Brown, Boveri generators, supplying 3-phase 50-cycle current at 4000 volts.

Figure 2 is a view of the three units in place. The turbines are of the standard exhaust steam type with reaction blading. Figure 3 shows the rotor suspended over the lower half of the casing. The turbine is built on the double flow principle, steam being admitted at mid-length and flowing both ways to the exhaust ports

at the ends. There are two exhaust flanges which bolt onto corresponding branches on the condensers, as shown in Figs. 4 and 5. The blading is divided into seven groups, of which five have brass blades, the two low-pressure groups having blades of 5 per cent nickel steel.

Glands, Fig. 6, have carbon packing rings that bear on the sleeve. By these precautions wear is reduced to a minimum and permanent tightness ensured. The section through the gland passes through the annulus by which live packing steam is admitted to the gland, giving sufficient pressure in this space to prevent any possibility of air leakage into the turbine.

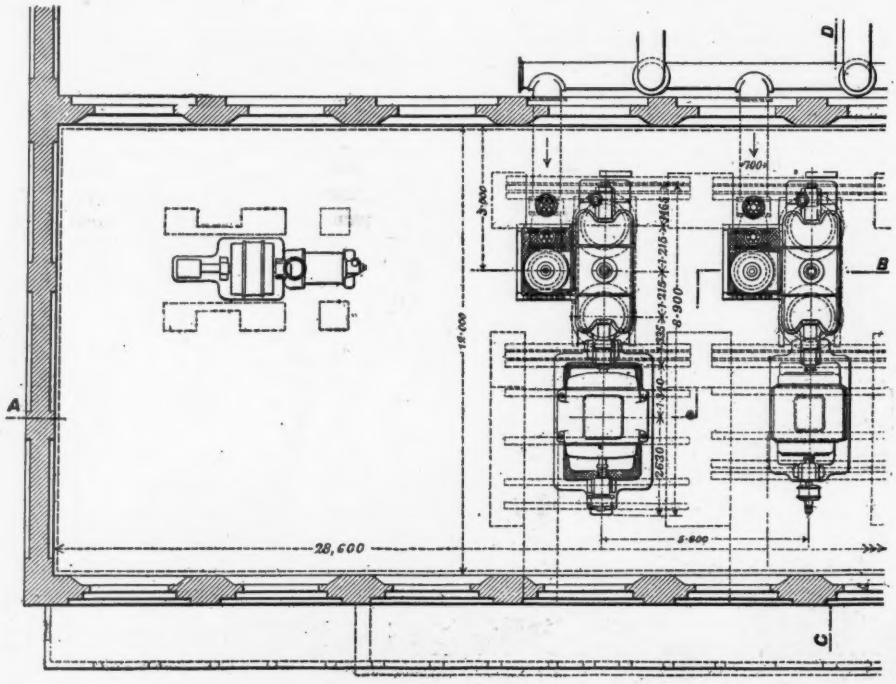


FIG. 4. PLAN OF POWER HOUSE SHOWING EXHAUST FLANGES BOLTED TO CONDENSERS

a thin steel sleeve which stands clear of the shaft, thus minimizing the possibility of distortion, since the steam in the annulus between shaft and sleeve keeps the latter at a nearly uniform temperature. The carbon rings are in four sections and are held together by helical springs embracing them. The rings are supported from below by flat springs, so that their weight is not carried by

With all exhaust steam turbines design of the valves is a crucial question. The volume of steam to be passed is enormous, and a loss of pressure at the valves, which might be insignificant in the case of high-pressure turbines, will materially reduce the output of an exhaust steam turbine.

Figure 7 shows a section through the main valve. The

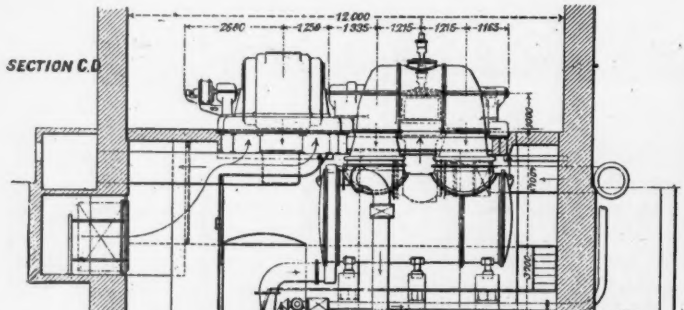


FIG. 5. UNIT SHOWING EXHAUST FLANGES BOLTED TO CONDENSER

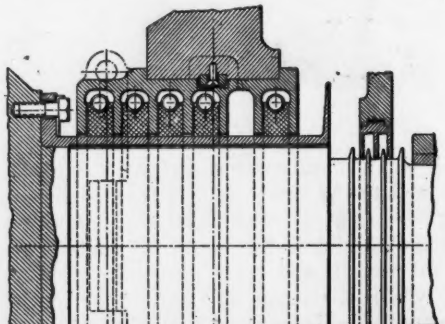


FIG. 6. GLANDS WHERE CARBON PACKING IS USED

stop valve V_0 and the governor valve V_1, are combined in the one casing, both being of the double beat type and designed to pass 90,000 lb. of steam per hr. at 2.5 lb. gage pressure. Steam enters the valve casing from below, the admission pipe being 27.5 in. internal diameter.

Provision is made for the expansion of this pipe without straining the valve, by employing a gland as indicated. The stop Valve V_0 is opened downwards by admitting oil under the piston S, which is coupled by appropriate link works to the lever L. The amount of the opening is controlled by the hand wheel N, by whjch

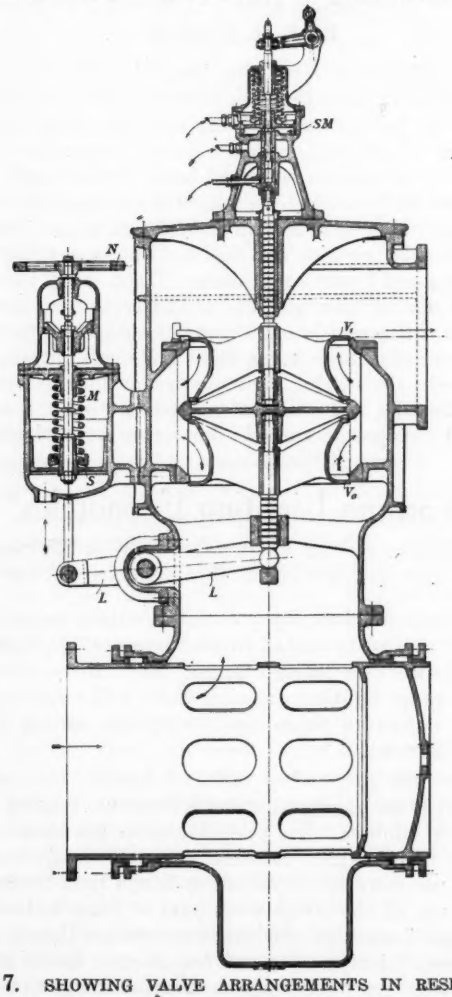


FIG. 7. SHOWING VALVE ARRANGEMENTS IN RESPECT TO TURBINE

the valve can be firmly locked in the closed position when desired. On releasing the pressure of the oil below, the position is forced down by the action of the spring M and closes the stop valve.

Governor valve V_1 opens upward and its position is controlled by regulating the supply and leak off of oil below the spring loaded piston SM. The valves which control this oil supply are of the piston type and are compactly and neatly arranged below and concentric with the piston SM. In turn, these valves are controlled by the governor in the usual way. There is also an oil-operated overload valve, which, under control of the governor, short-circuits part of the blading, and thus increases the weight of steam which passes through the turbine, thereby increasing the output.

A speeding gear electrically operated from the switchboard, permits small percentage of speed variation to meet conditions.

Each turbine has, as indicated in Figs. 1, 4 and 5, its own condenser immediately below with a cooling surface of 11,300 sq. ft. The air pump is of the water ejector type, condensate being handled by a centrifugal pump. With the bypass in operation, each turbine develops about 3000 kw. with steam consumption of 90,000 lb. an hour. Circulating water required is 9300 gal. per min., and as this is supplied from cooling towers, its temperature is never really low. The efficient working of the turbines is thus bound up with the efficiency of the air extraction and the makers state that with the ejector air pump fitted, the results have been highly satisfactory. For data and illustrations we are indebted to Engineering of London, Eng.

Painting Brass

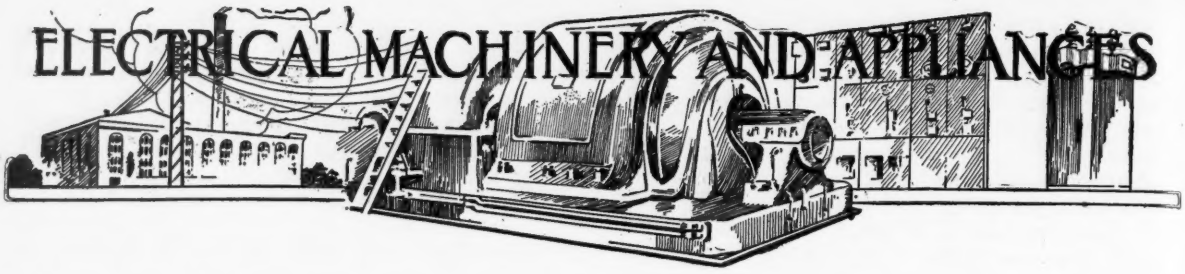
SHELLAC or paint will not harden or dry well on brass, and when ordinarily applied usually remains soft and can be rubbed off. Many claim that it is almost impossible to paint on brass in a satisfactory manner.

The following methods, however, have been used: Apply a little varnish, and then wash this with a solution of benzine. Another method is to apply varnish and then benzol in double the quantity of the varnish; afterward apply the paint, with a second coat a week or two later, if necessary.

THE U. S. NAVY has established on the grounds of Stevens Institute, Hoboken, N. J., a school known as the U. S. Navy Steam Engineering School for the training of engineer officers and for Naval Auxiliary Reserve. The graduates of this school will be the officers in the engine rooms of the transport and supply ships of the navy.

The qualifications for entrance are as follows: (1) 21 yr. to 40 yr. of age. (2) Thorough ability and officer-like character. (3) Completion of mechanical engineering, or electrical or civil engineering course in which stress has been laid on steam engineering, at "recognized" technical colleges, or possess an education and experience adjudged to be the equivalent thereof. (4) Be able to pass the physical examination for Naval Officers.

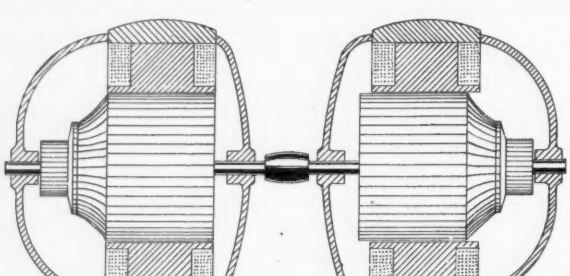
Applicants for admission will be inducted into the Navy as Apprentice Seamen and upon qualifying for admission to the school will be rated as Chief Machinist Mates at a salary of $83 per month and in addition lodging and subsistence. Graduates will be commissioned as Ensigns in the U. S. Naval Reserve Force. The salary of an ensign at sea is $155 per month if without dependents, and $185 if having dependents. Applicants for admission should apply to Ensign C. L. McIntyre, Assistant Mobilization Inspector, Eastern Division, 225 West 42nd St., New York.



Balancing Set Burning Out Armatures

TROUBLE was experienced with a 110-220-v. balancing set which was burning out armatures as fast as they could be replaced. A test was made on the fields for short-circuits and grounds, and brush holders were tested and no faults were found. The set was burning out only the armatures recently wound, which were always installed in the same side of the machine, the old armature remaining on the other side of the machine.

A thorough test was made of a repaired armature to be certain that it was in first class condition, also the armature in the side of the set that had not given any trouble. The machine was then assembled and started up. It had not run over an hour, when the armature on the side giving trouble started to throw solder and smoke. Shutting the machine down, the dimensions of the two armatures were taken and found to be the same, but dimensions of one spare armature showed the shaft



SHOWING POSITIONS OF ARMATURES UNDER POLE PIECES BEFORE CORRECTION WAS MADE

about 1 in. longer on the coupling side than the others. Examination of the positions of the two armatures under the pole pieces showed one armature directly under the pole pieces; this never gave any trouble. The other one, however, was not in line with the pole pieces; consequently when the machine was running, this armature was compelled to carry an excessive current, due to the reduced field, in order to deliver the same capacity as the other armature. This excess current heated the leads to the commutator, causing the armature to throw solder, hence open circuits and burn-outs.

The remedy to this trouble was to place one short and one long shaft together, which brought both armatures in the proper positions under the fields. No more trouble and burn-outs occurred since this was done.

Bending Thin-Wall Tubes

By B. J. Hartley

IT IS difficult to form long bends in thin-wall tubes or pipes or short bends in relatively thick wall tubes without kinking or flattening the tube or splitting it along one of the seams unless a proper procedure is followed. If the method described below is used, such accidents will be prevented. First, stop up one end of the tube which is to be bent with a soft wood plug. Second, hold the tube vertical and fill it with rosin which has been rendered liquid by heating. Third, bend the tube into the contour desired. The bend having been formed, the rosin filling can be melted out by subjecting the tube to the heat of a forge, a gas stove, a Bunsen burner, or a blow torch. In melting the rosin preparatory to pouring it into the tube, it should preferably be heated in a water-jacketed glue pot or some similar steam-jacketed utensil.

Wartime Lighting Economies*

Prepared by the Committee on War Service of the Illuminating Engineering Society

IT IS the patriotic duty of every citizen to see to it that no fuel is wasted in his service. The technical guidance here offered should make it possible for each to adopt lighting practice which will conserve fuel without impairing public welfare or diminishing useful accomplishment.

Do not use lamps when sufficient daylight can be had. Extinguish lamps when leaving a room unoccupied even for a few minutes. Use pilot flames on gas lamps. Do not use lamps which contribute merely to decoration. Do not use more lamps or larger lamps than necessary. Do not use all the lamps when part of them will suffice. Use single large high efficient lamps rather than a number of small lamps. Do not use electric lamps of the carbon filament type, tungsten-filament lamps are more efficient.

Do not use open-flame gas burners; mantle-burner lamps are more efficient.

Do not use blackened electric lamps or broken mantles or discolored chimneys. Do not use indirect or semi-indirect lighting fixtures with dark ceilings which absorb a large part of the light. Use light colored reflecting surfaces. Clean lamps, shades, globes, windows, etc., thoroughly and often.

*Presented at the convention of the Illuminating Engineering Society.

Arrange window shades to admit maximum daylight when desired. Ceilings and upper walls should be light colored and clean. Refracting or diffusing glass in windows helps to spread the light to distant parts of the room. Whitened surfaces on building exteriors give more and better daylight in opposite buildings. Keep windows and skylights clean. Dust window screens frequently. Remove them as soon as the insect season is past.

Shades and globes never increase the total quantity of light, but an efficient reflector will usually increase the light where it is needed. With such a reflector a small lamp may suffice, thus saving coal.

Good light tinted paint when fresh rarely reflects more than one-half of the light which falls upon it. The proportion of light reflected from good white lead and oil paint under average conditions diminishes by about 10 per cent a year. The same is true of calcimine and similar coatings.

Painting white ordinary light tinted surfaces may increase the light reflection by as much as 50 per cent.

Proper lighting display has a place in maintaining the morale of the people no less important than amusements and recreation. Display lighting also has a certain utility in providing necessary illumination. General and needlessly extensive display and inefficient methods of lighting display under present conditions are extravagant. In planning lighting of this character every economy of energy not inconsistent with reasonable effectiveness of the lighting should be sought.

In war times human energy and financial resources are to be conserved as well as fuel. Except in the greatest emergency it is unwise to save a little coal at the expense of waste of labor or impairment of health or menace to the safety of the public. Coal saved through the improvement of lighting equipment is clear gain. To diminish lighting standards in industrial plants, offices and other places where accomplishment depends in part upon vision is to reduce accomplishment or output. In such places, therefore, lighting should not be reduced. On the contrary, an increase in the standard of lighting may be the truest economy and in the best interests of the nation. The liberal use of light for protection of important property, munition factories, public works, etc., is likewise in the public interest, and under present circumstances no attempt should be made to save fuel through the reduction of such lighting.

Lamps should be so controlled that only those actually needed will be in use at any time. The greatest practicable use should be made of daylight.

Large lamps are usually more efficient than small lamps and where practicable installation should be altered to consist of the fewest lamps from which uniform illumination may be obtained under the conditions of use. Show windows should be lighted by lamps with efficient reflectors; by the use of these it is often possible to save from 25 to 50 per cent of the energy required for illumination without impairing the illumination in the window.

Hotel Lighting

It is suggested that waste in guest rooms be reduced to a minimum by having a notice, probably a card, placed near the door reading:

U. S. F. A. SEAL

"It is requested by the U. S. Fuel Administration that you kindly turn off the lights when leaving the room, and help save fuel."

While it is important as a measure of safety to keep stairways, passageways, and halls adequately illumined, it should be remembered that hall lights burn long hours, and in cases where convenience or safety is not menaced reductions as to number and size of lamps must be made.

Service rooms where lamps are allowed to burn constantly should receive consideration.

Home Lighting

Heating, cooking and lighting are mainly done by the use of fuel, and either directly or indirectly this fuel is mainly coal. So that to conserve fuel in either of these three uses there are two methods to be considered: Make sure of the efficiency of the appliance used; limit the time of its use to a minimum.

The percentage of fuel used in the homes of Americans for these three purposes is about as follows:

For heating (house and water)	87 per cent
For cooking	11 per cent
For lighting	2 per cent
	100 per cent

Home lighting is by means of two kinds of light—natural or daylight, and artificial light. To use the former properly is to aid in conserving the latter, which requires coal.

At periods near dawn and near dusk, and during the heavily clouded days we supplement daylight by artificial light; and many times we do this unnecessarily because we do not make maximum use of the daylight at hand.

Lighting Economies in Offices and School Rooms

Operate the lighting units for a given area only when such area is in use. They should not be turned on during any part of the day when the natural lighting will suffice.

Parts of the room remote from the windows may require artificial lighting when natural light is sufficient near the windows. Connect the switches, if possible, so that the light sources may be turned on in rows parallel with the windows, and the artificial lighting thus used in the several sections only as is necessary.

Cards or signs should be displayed prominently in the various rooms requesting tenants to turn on only such lamps as are necessary to their work and urging that all lamps be extinguished when daylight will suffice and when the tenant leaves his office.

Use bowl-frosted lamps with open reflectors and be sure that the reflectors are deep enough to protect the eye from the glare of the filament or mantle. Larger reflecting fixtures with glass diffusing bowls suspended below the lamps further soften the shadows and reduce the demand for local desk lighting. Indirect and semi-

indirect fixtures produce the best conditions for vision in school rooms and offices.

Windows should be cleaned at frequent intervals to allow the maximum use of daylight and limit the hours of artificial lighting.

Paint the light wells white. Where windows of offices are screened, the screens should be removed just as soon as the necessity for their use has passed.

Dust accumulating on school and office fixtures frequently reduces the intensity by 25 to 50 per cent. Clean the units regularly and at short intervals to insure maximum output.

White ceilings and light colored walls add greatly to the efficiency of any office or school lighting system. The added diffusion of light is also particularly valuable here. It is necessary that ceilings, especially, should be refinished whenever they become darkened. With indirect or semi-direct lighting the refinishing of the ceiling and cleaning of the lighting units will frequently increase the intensity 50 to 100 per cent, permitting a reduction in wattage to the next lower size of lamp.

In offices and school rooms the requirements of vision are exacting. The occupants must view fine detail work in one position for long periods. The light from a lamp therefore, enters the eye constantly from one direction and will prove annoying and harmful if too bright. Reflections from polished surfaces and sharp shadows also interfere with vision. If the general illumination is from amply diffused sources of proper wattage, all individual desk lamps may be dispensed with.

Economies in Fuel for Industrial Lighting

In almost every plant there is waste in the use of light, the elimination of which can be accomplished without retarding production, impairing the vision or menacing the safety of the employes by observing suggestions already given.

Flat reflectors allow much of the light to escape to the walls instead of directing it to the work. They also leave the bright light source exposed to view and the glare interferes with vision, causing a demand for still higher intensities. Use reflectors of the dome or bowl shapes for greatest economy. Except where lamps are mounted in high bay areas use bowl-frosted lamps to reduce glare reflected from the work and to soften shadows. Space lamps close enough to give uniform lighting and with reference to the work, so as to avoid bad shadows. This permits the use of a minimum wattage in the general lighting and makes it possible to remove most drop lamps or local lighting. Drop lamps within control of the workman are frequently burned by him throughout the day when no necessity exists.

So far as possible do all lighting from a general overhead system out of the control of individual workmen.

Bituminous coal production continued to decrease during the week of Nov. 9, dropping to a point below that for the corresponding week of either 1916 or 1917. The loss in capacity was more than half due to labor shortage, although in some districts there was a considerable car shortage. Decrease in shipments to New England was chiefly due to shortage of loading at tidewater at Philadelphia and New York. Rail shipments were greater than for the preceding week.

Method of Synchronizing Electric Machines

By Mark Meredith

A NEW method for synchronizing electric machines is a development from one already used. It consists in connecting choke coils in the alternating-current leads, bringing the machine to the neighborhood of synchronism by an auxiliary machine, and then gradually exciting. If the choke coils are suitably designed, the machine will fall into synchronism after one or two oscillations. When this has taken place, the choke coils are short-circuited, which gives rise to a considerable current rush.

It is also possible to use an induction motor for starting, with its windings connected in the place of the choke coils. This causes the reactance to decrease as the machine starts up. Even then considerable rushes occur when the induction motor is short-circuited. The reactance of the series choke coils is decreased automatically and gradually, to such an extent that practically no current rush takes place when they are short-circuited. A further advantage of the method lies in the freedom of choice of the type of the auxiliary motor. The reduction of the reactance of the choke coils is effected by superposing a direct-current field upon the alternating-current field. Direct current excitation of the choke coils may be drawn from the commutator of the rotary converter that is being started up, and the choke coils may be inserted either on the primary or on the secondary side of the stepdown transformers. It is only necessary to use a choke coil in one of the phases in a three-phase machine. The direct-current excitations may be also derived from any separate source. The choke coil may be designed with three limbs, the outer ones carrying the alternating current windings, and the middle one the direct current windings.

A man comes to America, takes out his first papers, declares his intention of becoming an American citizen. In the course of time he takes out his full citizenship papers, pays a few dollars in fees, and in his mind that settles it. Maybe it settled his citizenship in his mind—but it doesn't make him a citizen.

Because a man has a paper telling that he has complied with the technicalities of citizenship, does not make him a good citizen. It is going to cost more than that to make your son one. It is going to cost us friendliness and a certain amount of personal effort.

If a man comes into your plant and is ignored or sneered at by his fellow workmen who are Americans; if he is disputed with the final understanding is a punch in the jaw or a curse—those are the things America means thereafter to him. Those things are your explanation of Americanism. A man is more or less than human if he doesn't give as bad as he gets. On the other hand, there are few men in this world who are not ready to give a nod or a "hello" in return for a nod or a "hello." Americanism is to the foreigner or newly made citizen what you and I make it for him.

Specifications for Babbit Bearing Metals

AT ITS annual meeting, held at Atlantic City, N. J., June 25 to 28, 1918, the American Society for Testing Materials, proposed the specifications indicated in Practical Reference Tables of this issue, for babbit bearing metals, designated as grades Nos. 1 to 12, inclusive.

The society wisely refrained from recommending these formulas for any special purposes, confining themselves to the statement that "these specifications cover the range of alloys commercially used."

.It is regrettable that these tables do not also give the co-efficients of friction, as this information would have been perhaps a useful aid in determining the relative values of these 12 bearing metals—especially if tests had been made with water lubrication. But the society has made a good start and doubtless will give these frictional co-efficients at some future time.

However, the data furnished in these tables is useful for purposes of comparison, and the object of this article is merely to point out certain facts in connection with these figures that may have escaped general notice.

Many users of babbit, especially those required for heavy duty, are careful to specify "copper hardened" metals and certain manufacturers of babbit, knowing this predilection, boost "copper hardened" products. In this connection we call attention to formulas Nos. 3 and 8. The former is a tin base metal and contains 8⅓ per cent copper, the highest percentage of copper in any of these formulas. This composition, under 1000 lb. pressure per square inch, compressed to only 0.0010, or one one-thousandth of an inch, and its melting point is 462.2 deg. F.

No. 8 is a lead base metal, which contains no copper—under pressure of 1000 lb. per square inch compressed to only 0.0020, or two one-thousandths of an inch, and its melting point is 469 deg. F.

The difference between these two alloys under 1000 lb. pressure per square inch is only one one-thousandth of an inch, and the same relative difference between these two metals is maintained at 5000 lb. pressure per square inch.

As to the melting point of these two alloys—the lead base metal has the better of it by about 7 deg. F.

When considering that the tests shown in Table II were made by compressing a small cylindrical shaped block, and that in actual use a babbit metal would, in most cases, be supported by a backing and further bolstered by recesses, the difference in sustaining powers between a tin base copper hardened metal and a lead base metal is practically nil.

Table II also gives a good illustration of the influence of lead in tin alloys, as shown by No. 4. This composition contains but 10 per cent of lead, yet this small quantity was enough to reduce the melting point to 365 deg. F., which is about 5 deg. lower than the fusibility of half and half solder.

Attention is also called to the fact that the compressive strength of Nos. 10 and 11, which contain neither tin nor copper, is equal to that of No. 3 at 1000 lb. pressure per square inch, but at the higher pressure the No. 3 shows greater sustaining strength, due doubtless to its greater malleability, but such high pressures are rarely, if ever, used in actual practice. It is rather anomalous that alloys Nos. 1 and 2, which contain less copper and antimony than No. 3 should show greater resistance to pressure.

The conclusion that can be drawn from the foregoing figures is favorable to the use of lead base alloys for all bearing purposes except in cases where malleability is a prime requisite and paramount to all other considerations on certain forms of thin loose shell bearings.

The lead base metal is unquestionably superior antifrictionally to the tin base metals and by reason of that quality it wears longer, runs cooler and protects the bearing from the injurious effect of frictional heat, and it is much cheaper.

The lead base metal also has an advantage in pouring, as the tin base metal with high copper content has to be brought to a much higher heat to obtain the proper fluidity to obtain a good casting.

These figures of tests are doubtless dependable, and assuming that they are at least approximately correct, they unquestionably show the fallacy of using the copper hardened tin base metals merely to obtain compressive strength and apparently authorities in these matters have been taking a good many things for granted.

The fact that lead base metals are being used successfully under extremely high pressures is evidence that their failure in some instances where the tin base metals success is doubtless oftentimes due to improper handling rather than fault of the metal.

Bituminous Storage Limit Off

ALL STORAGE RESTRICTIONS on bituminous coal have been removed by the United States Fuel Administration in conformity to the action of the War Industries Board in canceling its preferential industries list. Anthracite coal is not affected, however, by the ruling of the Fuel Administration.

Every industry and every householder in the country now may store as much bituminous coal as desired or obtainable, as the action of the War Industries Board removes the necessity for the Fuel Administration to distinguish longer among different classes of industrial plants.

The restrictions just raised provided for the accumulation by the consumers in the preference classes defined by the War Industries Board of reserve stocks of bituminous coal, in accordance with their location in relation to various mine fields and their classification on the preference schedule.

All industries located farthest from distribution points, particularly those in New England and in the Northwest and found not only to be well stocked, in accordance with Fuel Administration specifications, but in many cases have surpluses above those amounts.

THE STEAM-ENGINE indicator, the Orsat, draft gage and the thermometer are the small arms of the industrial army. Are you armed and are you fighting?

Economic Conditions After the War

By Theodore Haight

NOW THAT the war is over we all hope, it certainly is about time to consider economic conditions from every angle that they may confront us, as we go back to the normal state of peaceful endeavor.

The extreme and one of the most common views, is that the return of our Overseas Force will overflow the labor market and probably precipitate a crisis, the other opinion holding that the reconstruction work on hand must cause a boom. It certainly is not healthy to await our fate unprepared, but rather we should try to protect our economic structure and therefore our prosperity, and individual comfort, against the possible shock of readjustment and how such protection is possible. As with every cause there is an effect, let us take careful judgment of the two above conditions.

In the first place, we all know that it has taken many months to transport our force across the Atlantic and in my opinion it will take longer to bring them back, for the simple reason that we have used every ship that could be begged, borrowed or possibly impressed into service, and with the fullest help of our Allies who realized that on their efforts depended their salvation. But when peace is finally declared will they have any incentive to rush our troops back? Well, not exactly.

When the history of this war is closed with a successful Allied peace, the ink will not have dried before the commercial plans will start working and our best bet in getting the boys back other than in our own ships seems to be the enormous amount of raw material required to start their commercial campaign, a considerable quantity of which must come from America; and our troops will be paying ballast for the one-way trip. Then again there is a considerable amount of police duty for the Allied armies while the terms of peace are being carried out; possibly territory to be occupied until the guarantees have been consummated, and probably the colossal job of straightening out the Russian situation. All of which brings in a time element which will materially affect the way the fighters and war workers are absorbed by the labor market.

Such delays as will occur between the day of peace and the last transport's start on its final homeward journey will give much money to France and Belgium, for our boys are good spenders. Besides which a considerable amount of material is purchased abroad for troop maintenance, which expenditure will do much towards getting the stricken section of France and Belgium on its feet, and may even result in absorbing some of our man power on reconstruction work in the desolated regions, the coal mining section of Laon, or the iron mines from Verdun to Metz, railroads, bridge construction, etc.

This war, like others, has resulted in a decrease in the production of consumable goods and an increase in their consumption which, along with the ever-increasing purchasing power and the employment of millions of men and women on war work at rising wages, in part has resulted in the abnormal price conditions. Fundamentally it is immaterial whether we hold the existence of inflation combined with the disruption between service and production or whether we hold the manner in which the purchasing power has been created, to be the criterion by which the degree of inflation is measured. The condition itself is now well recognized and while our production has been enormous and highly satisfactory for the speedy prosecution of the war, yet we have sacrificed efficiency for speed; we must rebuild our commercial enterprises for commercial competition and go through the process of deflation without causing disorganization or panic.

To cope with the impending situation it will be necessary to get in balance, not allowing a crisis to suppress the "demand" but by using our full efforts toward increasing the "supply" by methods of higher efficiency wherein each man or woman is able truly to earn the higher wage and that on a commercially competitive basis, and in some cases building up a stock of goods to meet the immediate demands when embargoes are removed and transportation facilities restored before foreign competition is renewed in full force.

This, combined with the probable time element previously referred to, will tend to control the labor market for a considerable period after peace is declared.

In addition to corporation and privately-owned enterprises much labor should be absorbed in public works, roads, and the building trades, which have been held up for some time, so as not to interfere with war work. The shipbuilding campaign must continue for several years if America is to have the merchant marine which most of us expect, not to mention the war losses to shipping which must be replaced.

Government expenditures will not and cannot be reduced to a peace basis for probably 5 yr. or more, and it will be necessary for the Government to raise money through loans and taxes in excess of the usual peace requirements for that period. Certainly all Americans can do most by proceeding with an optimistic view, remembering that the reconstruction period which will be required before we feel foreign competition will take many months and then on a re-arranged schedule which will be largely governed and affected by the political and geographic division of Europe when the matters of territorial division have been settled.

C. H. Huston, president of the Tennessee River Improvement Association, recently returned to Chattanooga from Mussell Shoals, bringing with him the cheering news that Maj. Watts, engineer in charge, has been instructed to resume work on the big power dams designed to be built there in connection with the nitrate plants, and work on which was suspended several months ago. The work is to be resumed just as soon as Maj. Watts can organize his forces. The first needful work will be the construction of cantonments for housing the workers on the dam project.

On November 9 the Engineers' Blue Room Club, of New York City, held a social meeting, at which 425 were present. Entertainment was furnished by the following artists: Rollo Hudson, Frank Martin, James Donnelly, Jack Armour, Bob Jones, Dan Harvey, Billy Murray and Wells Deveau.

Conservation of Heat Losses from Pipes and Boilers*

HEAT LOSSES FROM BARE SURFACES, INSULATED SURFACES CALCULATION OF HEAT LOSSES THROUGH COVERINGS, EFFECT OF AIR CURRENTS, PERMANENCY OF INSULATING QUALITIES OF COVERINGS, OPERATING EXPENSES DUE TO HEAT LOSSES, SELECTION OF COVERINGS. BY GLEN D. BAGLEY

THE data contained in the paper are a part of the results obtained in an investigation conducted for the Magnesia Association of America by the Mellon Institute of Industrial Research. The assistance received from the association and from the Administrative Staff of the Institute has materially aided in the successful progress of the investigation, and credit is also due to G. F. Gray, who was originally in charge of the work, and to R. H. Heilman, who has assisted in securing the data.

It is generally recognized that the losses from bare pipes and boilers are considerable, but the real magnitude of these losses is little appreciated. The fact that the loss from 1000 sq. ft. of exposed surface at 100 lb.

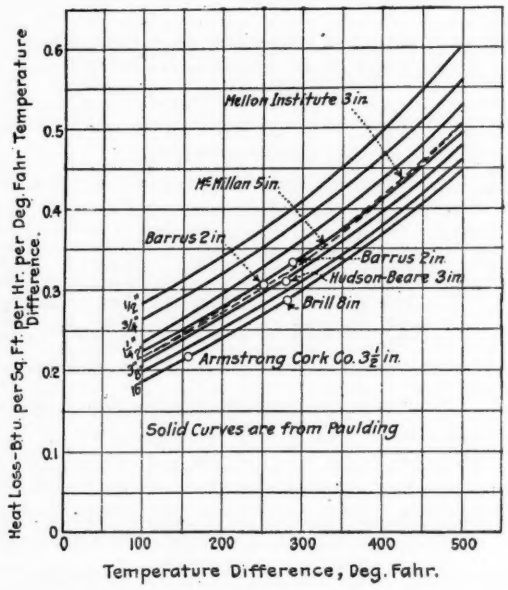

Heat Loss-Btu. per Sq. Ft. per Hr. per Deg. Fahr Temperature Difference.
Temperature Difference, Deg. Fahr.
Mellon Institute 3 in.
McMillan 5 in.
Barrus 2 in.
Barrus 2 in.
Hudson-Beare 3 in.
Brill 8 in.
Armstrong Cork Co. 3½ in.
Solid Curves are from Paulding

FIG. 1. HEAT LOSS FROM BARE PIPE

per sq. in. steam pressure amounts to over 300 tons of coal annually is sufficient justification for serious consideration of the subject.

HEAT LOSSES FROM BARE SURFACES

IN A STUDY of the conservation of losses, the first important fact to be considered is the actual value of the losses from bare surfaces. It is often considered that the loss from any bare surface is 3 B.t.u. per sq. ft. per hr. per deg. F. temperature difference between the surface and the surrounding air. While this value is correct for some special cases, it is by no means generally so. The size of pipe and the temperature difference have an important effect on the value of this constant. The curves of Fig. 1 show the application of Paulding's theory to horizontal pipes. The solid curves indicate Paulding's values, while the dotted curves and the points give the results of various experimental tests. The chart shows that the constant may vary from 50 per cent below 3 B.t.u. per sq. ft. per hr. per deg. F. to values far above it.

HEAT LOSS FROM INSULATED PIPES

THE NEXT important point in a consideration of the conservation of heat losses is the value of the loss after the pipes are insulated. Figure 2 gives a comparison of the losses from bare pipe with the losses through coverings 1 in., 2 in., and 3 in. thick. The contrast is very striking. The efficiency increases with the temperature as the loss from bare pipe increases much more rapidly in proportion than the loss from covered pipe.

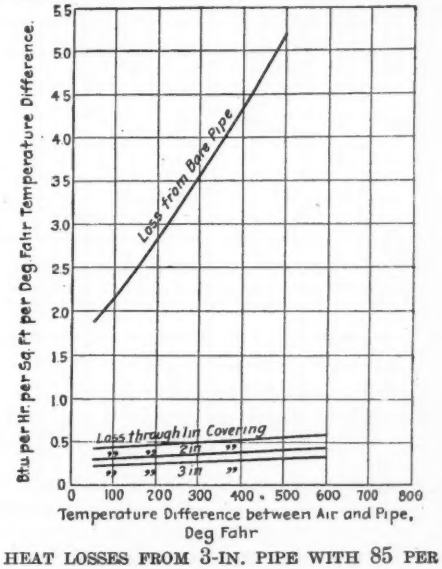

Btu per Hr. per Sq. Ft. per Deg. Fahr Temperature Difference.
Loss from Bare Pipe
Loss through 1 in Covering
" " 2 in "
" " 3 in "
Temperature Difference between Air and Pipe, Deg. Fahr

FIG. 2. HEAT LOSSES FROM 3-IN. PIPE WITH 85 PER CENT MAGNESIA COVERING

CALCULATION OF HEAT LOSSES THROUGH COVERINGS

THE THEORETICAL calculation of losses through coverings on flat surfaces is quite simple, but the problem of curved surfaces is much more difficult. In this case the effect of the increased cross-section and surface area must be taken into account. Since the conductance is directly proportional to the cross-sectional area and inversely proportional to the length of the path, it can be shown that the increment of heat loss is:

$$H = \frac{6.2832\,K\,(T_1 - T_2)}{\log_e \frac{R_2}{R_1}} \qquad (1)$$

* Abstract of paper presented at the Annual Meeting of The American Society of Mechanical Engineers.

where H = heat loss in B.t.u. per hr. per ft. length of covering
T_1 = temperature of surface of pipe in deg. F.
T_2 = temperature of surface of insulation in deg. F.
R_1 = radius of pipe in inches
R_2 = outer radius of insulation in inches
K = conductivity of the insulating material in B.t.u. per sq. ft. of cross-section per in. thickness per deg. F temperature difference per hr.

The loss through any pipe covering can be worked out by the use of this equation provided the value of K is known. K varies with the temperature and must be obtained from an experimental curve giving the value at different temperature differences above room temperature. The curve for K which was obtained during this research is given in Fig. 3. This curve takes into account only the conduction through the material as it is based on temperature measurements at the inner and outer surfaces of the insulating material and not on the temperature at the outer surface of the canvas covering or in the air.

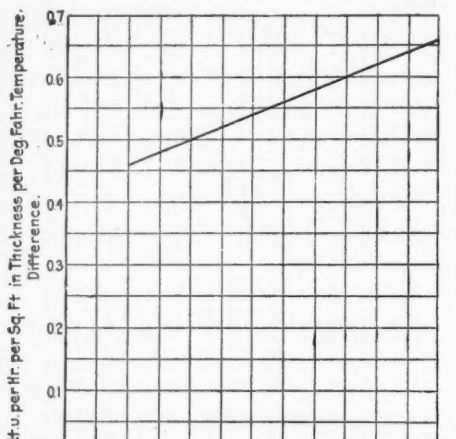


FIG. 3. ABSOLUTE CONDUCTIVITY OF MAGNESIA PLOTTED AGAINST TEMPERATURE DIFFERENCE AT SURFACE OF INSULATION

In Fig. 4 is given a curve showing this relation for the canvas covering as ordinarily used for this purpose. This curve was developed by L. B. McMillan at the University of Wisconsin and has been checked during this investigation. To use Formula (1) for a pipe covering in still air, an estimate of the heat loss per square foot of the outer surface of the canvas covering must first be made. From the curve of Fig. 4 an estimate of the temperature beneath can then be made. Knowing this temperature and the temperature of the pipe, the term $(T_1 - T_2)$ of the formula is determined and the loss calculated. If this checks fairly well with the estimate of the loss from the outer surface, the calculation can be considered to give the proper value for heat lost. If not, the estimated loss from the outer surface must be changed according to the indication of the calculation and the calculations repeated until the estimated and calculated losses check.

In case it is desired to compute the loss per square foot of pipe surface instead of per lineal foot of covering, the formula becomes:

$$H = \frac{K\,(T_1 - T_2)}{R_1 \log_e \frac{R_2}{R_1}} \qquad (2)$$

Table I gives the value of the terms $R_1 \log_e \frac{R_2}{R_1}$. The physical meaning of the figures in this table is the equivalent thickness on a flat surface of the given thickness on the given size of pipe. For example, a 3-in.-thick covering on a 3-in. pipe is equivalent to a covering 1.75 in. thick on a flat surface.

An investigation was made to determine the distribution of temperature about a covering in still air, which shows that no considerable error is made by assuming equal temperature distribution at the surface of the insulation in making the calculations.

TABLE I. EQUIVALENT THICKNESS ON A FLAT SURFACE OF VARIOUS THICKNESS COVERINGS ON DIFFERENT-SIZED PIPES

Pipe Size, In.	Thickness of Covering, In.				
	1	2	3	4	5
¼	0.560	0.823	0.897	1.130	1 240
1½	0.679	1.073	1.350	1.570	1.740
3	0.790	1.332	1.750	2.080	3.360
6	0.878	1.565	2.135	2.620	3.040
12	0.925	1.740	2.460	3.080	3.680
24	0.960	1.843	2.680	3.400	4.150

Some tests have been made and others are now in progress to determine the effect of wind velocity on the losses from bare and covered pipes. The apparatus used to determine this effect consisted of a 35-in. Sturtevant blower driven by an 8-hp. direct-current motor which furnished a blast of air for a wide tunnel. The apparatus used for testing pipe coverings was arranged inside of the tunnel so that the axis of the pipe coincided with the axis of the tunnel. This caused the air to travel parallel to the axis of the pipe and gave a condition similar to that encountered in locomotive practice.

The first test was made with a 3-in. thick magnesia covering on the test pipe, a temperature difference of 460 deg. F. between the pipe and the wind and a wind velocity of 30 m.p.hr. Under this condition the loss was 0.430 B.t.u. per sq. ft. of pipe surface per deg. F. temperature difference per hr. Under normal conditions of still air, the loss was 0.302 B.t.u. This shows an increase of about 40 per cent due to the wind velocity.

The curve of Fig. 4 shows the temperature beneath the canvas for any condition of loss in still air. When calculations are being made for exposed pipes, the loss should be calculated both by use of this curve as ex-

plained before and by using the temperature of the pipe and the temperature of the air for T_1 and T_2. By comparing the loss in still air and the maximum loss which may be caused by wind, an idea of the probable increase due to exposure can be obtained and extra thick insulation applied accordingly.

The last important point in considering pipe coverings is the permanency of their insulation value. In the case of a 1-in. thick covering which had been in service at the Armour Glue Works in Chicago for 8 yr., the conductivity was found to be slightly lower than the average of the new 1-in. coverings tested, showing that no deterioration in service had taken place. Several sections were obtained which had been saturated with oil. Tests on these showed much lower insulation values than new coverings. The damage was permanent and shows that care should be used to protect coverings from oil while in service.

In most cases the result desired is the maximum net saving of money for any given condition. If the covering cost were nothing, the proper thickness would be limited only by the requirements of space available, as each increased thickness would result in some slight increased saving in heat. In a practical case where the covering has a finite cost, a point is soon reached where the increased cost of the covering would be greater than the additional saving in heat effected. After considerable investigation, it was decided that 20 per cent of the list price of the covering would be

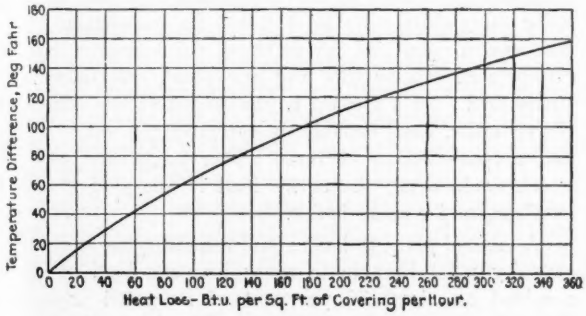


FIG. 4. TEMPERATURE DIFFERENCE BETWEEN INNER SURFACE OF CANVAS COVERING AND ROOM FOR DIFFERENT HEAT LOSSES

allowed as the cost of application, and 13 per cent of the total cost as the annual charges (6 per cent interest, 5 per cent depreciation and 2 per cent insurance and miscellaneous).

Operating Expenses Due to Heat Losses

The other cost to be charged to the operating expenses of the covering is the value of the heat losses through the different thicknesses of coverings. The assumptions used in making this conversion were that the cost of coal is 75 per cent of the cost of steam, that 1 lb. of coal as burned will evaporate 7 lb. of water from and at 212 deg. F., and that each pound of steam contains 1000 B.t.u. above the feed water temperature.

By combining the fixed cost and the heat losses per square foot per year, the total operating expenses were obtained. Once these are obtained, it is simply a matter of picking that thickness which gives the minimum annual operating expenses to obtain the proper covering to use. It is evident that the thickness which gives the minimum operating expense also gives the maximum net saving, as the loss from bare pipe is a constant under given conditions and the net saving is the difference between the operating expense and the loss from bare pipe.*

TABLE II. COAL SAVED BY 85 PER CENT MAGNESIA COVERING 1 IN. THICK

Steam Pressure	Saturated 5 Lb.	Saturated 10 Lb.	Saturated 50 Lb.	Saturated 100 Lb.	Saturated 150 Lb.	Saturated 200 Lb.	200 Lb. Pressure with 100 Deg. Superheat
Steam temperature, deg. fahr.	228	240	298	338	366	388	488
B.t.u. loss per hr. per sq. ft. bare pipe	367	409	625	802	937	1058	1735
B.t.u. loss per hr. per sq. ft. of pipe covered with 85 per cent magnesia	69	76	105	126	142	153	210
B.t.u. saved per hr. per sq. ft. by covering pipe with 85 per cent magnesia	298	333	510	676	795	905	1525
Tons (2240 lb.) coal saved per 10,000 sq. ft. per year of 8760 hr. by pipe covered with 85 per cent magnesia.	1190	1330	2080	2700	3180	3620	5650
Cars of coal saved per year, as above, at 40 tons per car	30	36	52	68	80	90	140

Coal efficiency taken at 14,000 B.t.u. per lb. with boiler efficiency at 70 per cent.

The saving in coal tonnage and car capacity accomplished by applying 1 in. thick coverings to 3-in. pipe is shown in Table II.

There is every indication that Liberty Loan Bonds, issued during the war, will greatly rise in value. In 1888 a $100 United States bond, bearing 4 per cent interest, sold in the open market for $130. In 1901 it brought more than $139. The most conservative will agree that Liberty Bonds are sure to go above par in value, now that the Allies have brought the war to a victorious end.

The shrewd and unscrupulous, the birds of prey in finance, realize the worth of Liberty Bonds, and are using every effort to secure them from those who are uninformed in financial matters. Their favorite method is to offer stock in wildcat companies—stock that is absolutely valueless—in exchange for Liberty Bonds. Some of these get-rich-quick schemers offer to lend their prospective victims money, wherewith to buy the gold-brick stock, taking Liberty Bonds as security. This, of course, is only a thinly disguised attempt to obtain Liberty Bonds for worthless stock.

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* Tables and charts of proper thickness as given by the author in his paper were published in the Reference Tables of the September 15 issue of Power Plant Engineering.—Editor.

Industrial Power Problems*

RELATIVE IMPORTANCE OF RELIABILITY AND COST OF POWER; CONDITIONS AFFECTING RELIABILITY; COMMON SITUATIONS OF POWER SUPPLY. BY W. F. UHL

THE two principal sources of power for industrial purposes at this time are steam and water-power plants owned and operated by the industry, the so-called isolated plant; or the purchased electric current from the public-service power companies, the so-called central plant or system.

The principal points which must be considered when provisions for a power supply for an industrial plant are to be made are reliability and cost. The relative importance of these two items is in the order stated and for many plants the last item is comparatively unimportant.

Conservation of fuel, which until recently received consideration only as a part of the cost of power, is now an important factor from a standpoint of reliability also. Within the last year it has become apparent that the important thing is to have power, no matter from what source; and within very wide limits, no matter at what cost.

RELIABILITY

THE PROPORTIONATE cost of power to the total cost of the commodity produced for sale in most industrial plants is below 5 per cent; and, as already stated, reliability is of much greater importance than cost when considering the supply of power for such plants. An analysis of any power situation should therefore first consider the relative reliability of the various sources of power.

When considering reliability, our first thought is generally related to shutdowns. The loss due to complete failure of power supply, when translated into dollars per hour or other time interval, is one of the uncertain quantities which makes the question of reliability so difficult of solution. This loss is subject to determination if we make certain assumptions. For instance, if we have a plant that operates continuously, the loss due to a shutdown can be directly calculated in terms of average profit, plus idle labor cost, plus spoiled stock in process, plus fixed charges. As most plants do not operate continuously, the time lost during shutdowns can generally be made up, at least to some extent, and the loss may be reduced to the cost of labor only if the nature of the industry is such that stock in process will not spoil.

RELATIVE RELIABILITY

RELATIVE RELIABILITY is also somewhat indeterminate, but there are certain factors which have an important bearing on the subject. Ignoring the question of shortage of fuel, which it is hoped is only a temporary problem, and assuming equal reliability of plant, steam power is more reliable than water power, excepting certain noteworthy cases. The chief sources of unreliability of water powers are variability of steam flow, ice troubles and floods. In most cases water power must be supplemented to some extent by auxiliary steam or other source of power to make it equally as reliable as steam power alone.

Relative reliability as between the power obtained from the isolated plant and that obtained from a central plant or system depends upon the following principal factors: (1) Size of plant; (2) reserve capacity; (3) quality; (4) transmission.

SIZE OF PLANT. Unless the central plant is several times the size of an isolated plant of 500 kw. or greater capacity, it would be unusual to obtain greater reliability because of the factors which are generally considered as having a tendency to promote reliability merely on account of size. Such factors are—design, quality of supervision, equipment, location, etc.

The average 1000-kw. isolated plant does not receive the attention in design, supervision, etc., that the average 10,000-kw. plant receives, but it would be a mistake to assume from this that all small plants are poorly designed or supervised or that there are no 10,000-kw. plants which are not poorly designed or supervised.

RESERVE CAPACITY. An isolated plant can be said to be thoroughly reliable if it has an installation such that any one unit, as, for instance, prime mover, boiler, pump, etc., can be idle and the plant still carry the entire load. Such a plant might consist of two complete power units, each capable of carrying the entire load, and a spare boiler, or three power units, any two of which could carry the entire load if operated at some overload, and a spare boiler.

A central plant to have equal reliability as to reserve capacity must be able to carry its peak load at some overload on about 75 per cent of its rated capacity, depending to some extent on the number and size of units installed. If the isolated plant operates only nine or ten hours a day and is usually shut down over Sunday, it can get along with less reserve capacity than the central plant operating continuously, as there are more opportunities to make extensive examinations and repairs.

QUALITY. When speaking of quality of power, we refer to those characteristics which affect the speed and efficiency of the motors, such as speed variation and voltage regulation. These characteristics of power also affect both the quality and quantity of the product of many industries.

Speed variation is apt to be less in the average central plant, due to the larger amount of connected load and its diversity. Motors which are large compared with the total load and which carry a variable load are a source of poor-speed regulation, whether connected to the isolated or central plant. Better voltage regulation

*Abstract of paper presented at the annual meeting of the American Society of Mechanical Engineers.

is usually obtained from the isolated plant because of the absence of transmission lines.

TRANSMISSION. The one great weakness of central-plant power service is the necessary transmission. Even if the transmission is of the best and thoroughly protected by placing it in underground conduits or otherwise, it is always a source of possible trouble with which the isloated plant does not have to contend.

Under favorable conditions, this element of unreliability may be almost negligible, but more often, especially with long overhead transmission, it is the greatest source of shutdowns and poor voltage regulation in the present state of the art of power generation and use. It affects those industries most which are liable to have stock in process spoiled, due to shutdowns, or which produce a poorer grade of material on account of non-uniformity.

SITUATIONS

IT IS POSSIBLE to define a number of fairly common situations of power supply for industrial plants and to determine certain limits that it is well to keep in mind when making a comparison in which reliability, cost, conservation and policy are all considered.

An attempt is then made in the complete paper to outline a few such situations and in doing so only demands of power of 500 kw. or more are considered and these entirely in the form of electrical energy. The situations are as follows:

Situation A. An industrial plant which has no water power and no demand for exhaust steam or hot water.

Situation B. An industrial plant which has a water power of ample capacity to carry the entire load a portion of the time but must have auxiliary power in some form during lowwater periods and has no use for exhaust steam or hot water.

Situation C. An industrial plant which has a small water power, of insufficient capacity to carry the entire load at any time, and has no use for either exhaust steam or hot water.

Situation D. An industrial plant which requires all or more than all of the heat which can be made available from a steam-power plant in the form of either low-pressure steam or hot water or both.

Situation E. An industrial plant which can use only a portion of the heat which could be made available if all power required were made by a steam-power plant.

Situation F. An industrial plant which has a water power of ample capacity to carry the entire load a portion of the time, but must have auxiliary power in some form during low-water periods and could use all heat which would be available from a steam-power plant.

Situation G. An industrial plant which has a water power of ample capacity to carry the entire load a portion of the time, but must have auxiliary power in some form during low-water periods and could use only a portion of the heat which would be available from a steam-power plant.

Situation H. An industrial plant which has a small water power, of insufficient capacity to carry the entire load at any time, and which would have use for all heat made available by a steam-power plant at all times.

CONCLUSIONS

RELIABILITY of power supply is of much greater importance to the average industry than the cost of power. If the cost of power were doubled, it would be hardly noticed on the balance sheet of many industries, but shutdowns and speed drop or variation of speed may make a decided difference.

Cost and reliability being nearly equal, it would ordinarily be policy to purchase power where available. If the central plant from which the power is purchased is relatively large and has a fair load factor, this would tend toward fuel conservation.

Where an industry requires considerable heat for manufacturing and heating purposes, power can generally be made cheaper than it can be purchased, and fuel would also be saved by making rather than purchasing power in such a case.

Water power owned by an industry in many cases bears the same relation to it as does purchased power. If it is located at the industry it is often a form of reliability insurance to maintain a water power, even if there is no apparent saving due to its use.

Water powers that save coal should be maintained in any case, and there is a splendid opportunity to save fuel by re-development of inefficient water powers.

There exists a field for fuel conservation and financial gain for both central plant and industry, in the possibility of isolated-plant operation by the former.

In the case of water powers owned by industries running only eight to nine hours a day, the saving is of decided importance.

Under certain conditions the saving which would result from central-plan operation of isolated steam plants is also considerable.

Suggestions for Safety

SAFETY of the workers in a plant is an important part of the responsibility of any executive, be he manager or engineer. The following suggestions of the Bureau of Safety of Chicago are worthy of careful attention.

In making an inspection, the important question is—Can an accident occur? Not—Has an accident occurred?

Inspect out-of-the-way places. Accidents frequently occur where it has been said, "No one ever goes."

Look not only for places where new guards are required, but see that old guards are being used. A guard out of place is no guard.

See that the suggestions for safe practices which were made and approved at the last Safety Meeting are being put into practice.

Make notes on all unsafe conditions and practices in plants, in yards, on the lines, in cars or barns and along trackway, to discuss at next meeting.

When you have completed the inspection, check up and see if you have forgotten anything.

Fuel Administration Helps

SINCE the publication of the December 1 issue, the following letters have been sent to all power plants in the state of Illinois by Joseph Harrington, Administrative Engineer. These are in the series of weekly letters being prepared and distributed as part of the work of the Fuel Administration in aiding power plant owners and engineers to increase the efficiency of their plants:

GENERAL LETTER NO. 5

Radiation Losses From Steam Heated Surfaces

By steam heated surfaces we mean drums or shells of boilers and steam piping such as boiler feed lines, hot water returns and the like.

This is one of the most easily accounted for losses in the power plant, and it is one for which no excuse can be given. The cost of covering steam pipe is so quickly made up by the saving which results therefrom, that uncovered piping or parts of the boiler should not be tolerated for a single day.

To give you an idea of what it means to have uncovered steam and hot water piping, a table is given herewith. All you have to do, to find out how much coal you are wasting is to determine the steam pressure or hot water temperature measure the amount of uncovered surface and multiply the square feet of uncovered surface by the figure in column 5 which corresponds to the steam pressure. For example, when the steam gage shows 100 lb. pressure there is a waste of 718 lb of coal per year for every square foot of exposed pipe.

There are a number of excellent materials readily obtainable for covering steam piping and boiler drums. Will you please, therefore, without delay make a detailed examination of your piping, list the various sizes and lengths of exposed pipe, and place the order at once for the necessary covering. I will ask you, also, to write a letter to me, with a copy to your district chairman, within one week of the receipt of this letter, stating whether you have taken the necessary steps for the covering of your piping, and advise me when the piping will be covered, if it is not now.

A table of approximate cost of magnesia covering is given for your convenience in figuring the probable cost of your work. The cost of this work is the initial cost only, because pipe covering will remain in place indefinitely, unless it is deliberately destroyed. Here we have the means of a direct and inexpensive conomy which I know you will not fail to avail yourself of.

GENERAL LETTER NO. 6

Boiler Scale Prevention

The importance of this subject can be appreciated better when you realize that no boiler is without scale and that all scale results in fuel loss. Exceptions to this rule are so few as to be negligible.

The very fact that you have to use a tube cleaner or turbine is sufficient evidence to prove that you have scale. It makes no difference whether you turbine your boilers once a week or once a year, the average thickness of scale is equal to one-half the thickness at the time of removal. Another thing you must not overlook, and that is that the only proper place to remove the scale forming elements is before the water enters the boiler; and another equally important fact, that this is a perfectly possible and economical thing to do.

Very careful and extensive experimentation in this matter was conducted by Prof. Schmidt, at the Uni-

RADIATION LOSSES

A square foot of ordinary bare pipe will radiate approximately 3 B.t.u. per square foot per hour per degree difference between the temperature of the pipe and the outside or room temperature. A properly covered pipe, however, radiates only about 3 B.t.u. per square foot per hour. A convenient table giving the lengths of pipe of various sizes per square foot of outside surface follows:

TABLE A

Pipe size diameter inches	Length of pipe in ft. per sq.ft. of external surface.	Length of pipe in in. per sq.ft. of external surface.
1	2.9	34-13/16
2	1.6	19-7/32
3	1.0	12
4	0.84	10-3/32
5	0.68	8-3/16
6	0.57	6-27/32
8	0.44	5-9/32
10	0.35	4-7/32

TABLE B

ORDINARY STEAM TEMPERATURES

Temperature of Surrounding Air 70 Deg. F.

1 Steam Pressure (Gage)	2 Steam Temp. (Deg.F.)	3 Dif.Bet. temp. of steam & surrounding air (Deg.F.)	4 Loss per sq. ft. per hr. B.t.u.	5 Waste of coal in lb. per sq. ft. per year	6 Sq. Ft. of bare surface wasting 1 ton coal per year
0	212	142	334	293	6.82
10	240	170	425	372	5.38
25	267	197	522.5	458	4.37
50	298	228	644	564	3.55
75	320	250	737.5	646	3.10
100	338	268	820	718	2.79
150	366	296	960	840	2.38
200	388	318	1079	945	2.12
250	406	336	1184	1036	1.93

TEMPERATURES LOWER THAN 212 DEG. F.

1 Water Temp. (Deg.F.)	2 Dif. Bet. water temp. & surrounding air (Deg.F.)	3 Heat loss per sq.ft. per hour (B. t. u.)	4 Waste of coal in lb. per sq. ft. per year	5 Sq. Ft. of bare surface wasting 1 ton coal per year
100	30	56.6	49.6	40.3
120	50	97.5	85.4	23.4
140	70	142.0	124.3	16.1
160	90	190.0	166.3	12.03
180	110	242.0	212.0	9.44
200	130	298.5	261.5	7.65

PRICES OF MAGNESIA PIPE COVERINGS

For conveniently estimating cost of work

1 Inside dia of pipe inches.	2 Thickness standard covering, inches.	3 Price per lineal ft. canvas jacketed.	4 Thickness of covering, inches	5 Price per lineal ft canvas jacketed.
1	7/8	0.27	1-1/2	0.52
2	1-1/32	0.36	1-1/2	0.64
3	1-1/32	0.45	1-1/2	0.76
4	1-1/8	0.60	1-1/2	0.88
5	1-1/8	0.70	1-1/2	1.00
6	1-1/8	0.80	1-1/2	1.10
8	1-1/4	1.10	1-1/2	1.35
10	1-1/4	1.30	1-1/2	1.65

versity of Illinois and the following table is based on the results of his researches:

TABLE A

Character of Scale	Thickness, in.	Composition	Loss of Efficiency, Per Cent
Hard	1/50	Mostly carbonate	5.4
Soft	1/32	Mostly carbonate	7.2
Hard	1/32	Mostly carbonate	8.5
Soft	1/25	Mostly carbonate	8.0
Hard	1/25	Mostly sulphate	9.3
Hard	1/20	Mostly sulphate	11.1
Soft	1/16	Mostly sulphate	10.8
Soft	1/16	Mostly carbonate	11.0
Soft	1/16	Mostly carbonate	12.4
Hard	1/16	Mostly carbonate	12.6
Soft	1/11	Mostly carbonate	15.0
Hard	1/9	Mostly sulphate	15.9

Do not content yourself with the thought that you are having no trouble with scale. You can only have no trouble when you have no scale. Why wait until you have bagged your boiler, burned out tubes or wasted a lot of coal before taking action in this matter? Impress upon your memory the fact that the first thin layer of scale is the most injurious. Stated somewhat more scientifically, the rule is that the insulating effect varies as the square root of its thickness. To illustrate, the insulating effect of scale of thicknesses 4, 9 and 16 is 2, 3 and 4. Scale of the thickness of 4 insulate 2, while it requires a thickness of 16 to insulate 4, or four times as much scale to produce twice the insulating effect.

To give this matter point and talk in terms of coal the following table is given:

TABLE B

Average Thickness of Scale, In.	Coal Wasted from Every Ton Fired, Lb.
1/50	100
1/32	140
1/25	180
1/20	200
1/16	220
1/11	300
1/9	320

The use of boiler compounds is unquestionably better than no treatment at all; but it seldom, if ever, accomplishes real satisfactory results. If the compound is a chemical and reacts with the scale forming material in the water, it can only change this material to something else which is commonly known as sludge. When this occurs, the sludge is deposited on the boiler heating surfaces as a soft mud-like substance which is not scale, but which has an insulating effect and which, if excessive, may actually result in burning the plates of the boiler. To avoid its becoming excessive, the boiler is blown down frequently, which is a direct loss of heat and waste of coal.

You will observe from the foregoing that the writer takes no middle ground in this matter. There is only one right condition, and this is perfect cleanliness. If you think that there is an objection to properly softening your boiler feed water in advance of pumping it into the boilers due to the cost of installation, look over the second table above and figure out what it costs you now per year with your present water and its consequent scale. You will find that in all probability the cost of proper water treatment would be paid for inside of two years, including the cost of operation. Water as pure as Lake Michigan water comes in this class.

In conclusion, remember that it is possible so to purify your water that no scale will form in your boilers.

Will you please, therefore, start immediate investigation as to the matters considered above?

GENERAL LETTER NO. 7

BOILER ROOM RECORDS

BEFORE CONSIDERING some of the other matters so necessary to boiler room efficiency, I want to have each and every reader of this letter make preparations at once for a proper accounting in his boiler room.

You can no more analyze your boiler room situation without appropriate records than your auditor can analyze your production costs without a proper set of books. Practically all large power plants have some record system, but the vast majority do not; and in order to aid those of you who do not now have some such record, I have caused to be published in the Oct. 1 issue of Power Plant Engineering a form which will be suitable in practically all cases. These can be secured from this publication, whose address is 537 S. Dearborn St., Chicago, Ill.

If you will faithfully fill out the columns in these forms I will at a later date, analyze each and every column and show just how it affects your efficiency. Not only will it enable you as plant manager to find out your costs, but it will enable you to analyze the results and determine where the losses are. You will then have a means of plugging up the leaks and fattening your pocket book.

For those of you who are operating engineers, it will be the means of enabling you to keep tab on your plant conditions, and will shortly put you in possession of facts that will cause you to be proud of your record.

Pride in your profession is an incentive which is sufficient for the engineers of Illinois. Let us get together and develop conditions which will make Illinois a leader among the states of the Union.

SPECIAL LETTER

THE REMOVAL OF SOOT DEPOSITS FROM STEAM BOILERS AND HOUSE-HEATING FURNACES

THE PECULIAR situation in the State of Illinois, arising from the accumulation of soot in household furnaces, induces me to include in this letter reference to this type of furnace. The cleaning of the heating surface in this type of boiler may be accomplished in exactly the same manner as in the case of a large power plant boiler, so that one communication will serve both purposes.

One of the most difficult problems which conservation engineers in the State of Illinois encounter in the burning of local coal in both steam boilers and house-heating furnaces is the removal of the excessive deposit of soot and tarry substances on the cold heating surfaces of the boilers. This tar or soot has an insulating value far in excess of any commercial insulator. One-eighth of an inch of soot on a boiler reduces the transmission of heat approximately 10 per cent for 1/32 in. and 20 per cent for 1/16 in. In view of the well known fact that heating surfaces quickly become covered with soot as thick as the foregoing, the great importance of some method of removing it becomes apparent.

It gives the writer considerable pleasure to be able to advise both power plant and domestic operators of boilers that a method has been discovered whereby it is entirely feasible to remove soot without the necessity of letting down the boiler, or additional expenditure of labor. It is my pleasure to acknowledge the debt I owe to C. J. Causland, Electrical Engineer of the Pennsylvania Railroad Company, Chicago District, and Jerome Kohout, Chief Chemist of the Commercial Testing & Engineering Co., Chicago, for their suggestions and assistance in developing the facts relating to this process.

This process is in brief, the application of common salt to the fire under conditions which will produce dissociation of the sodium and chlorine forming the salt and the subsequent combination of these elements with the carbon of the soot to form a substance which then passes off as a gas or drops off of the heating surface. The practice is briefly as follows:

The fire is put into good condition with a substantial body of hot fuel. Common salt, previously dried, is then thrown or sprinkled onto the incandescent fuel bed, in a quantity depending entirely on the size of the furnace. In the case of a household furnace, a pound at a time is ample; in the case of a large power plant boiler, four or five scoops full may be required. The dampers are kept open so as to maintain the furnace temperature and the salt is allowed to remain until the fumes have entirely disappeared.

Immediately upon charging the salt, the furnace becomes filled with dense white fumes which may require as much as half an hour to entirely disappear. If results are not secured on the first application, it should be repeated as many times as necessary. Once the heating surface is thoroughly cleaned, a small application every few days is usually sufficient to keep it so.

Common salt is composed of only two elements—sodium and chlorine. Both are very reactive substances; the first, a metal, and the second a corrosive gas. When salt is thrown upon incandescent coal, it is vaporized and probably decomposed, at least in part, into its original elements. The chlorine, being acidic in character, would attack the iron in the iron oxide incrustation and form a chloride of iron. Ferric chloride is volatile in high temperatures and would, therefore, disappear in the form of gas; or at least, a sufficient amount would be volatilized to render the deposit porous and weak and so loosen it that it would fall from the tubes of its own weight.

The sodium of the salt would immediately oxidize to sodium oxide, or sodium peroxide. This material being basic, would not attack iron, but would be carried out of the furnace and deposited with the soot on the heating surfaces of the boiler. The sodium oxide would thus introduce oxygen into the carbonaceous matter in the soot, and at an elevated temperature would cause an oxidation of this material. Carbon dioxide and carbon monoxide are gases which would pass out of the stack with the furnace gases.

The foregoing is more or less hypothetical, but inasmuch as there is no literature or direct experimental evidence of the action of salt in this manner, I am under the necessity of assuming that the above reasoning is at least sufficiently probable to explain the definitely known results that occur.

The application of this method of cleaning heating surfaces, presents possibilities which are of tremendous significance to power plant owners.

The boiler can be cleaned when in service without the use of special equipment, extra labor or interruption to the use of the boiler. The heating surfaces are cleaned to the utmost corners and two years' experience shows absolutely no deterioration of either brick work or boiler tubes. It is an economy which represents enormous savings and all the evidence at hand shows it to be thoroughly practical.

In domestic service it frequently represents not merely an economy, but makes possible the use of apparatus which otherwise could not be used. Domestic furnaces get so clogged up with soot that they are absolutely useless and on account of the peculiar construction of some of them, their heating surfaces cannot be reached for proper mechanical cleaning. The salt method, therefore, means everything. The actual cost of the salt used is so slight as to be scarcely a factor in the matter.

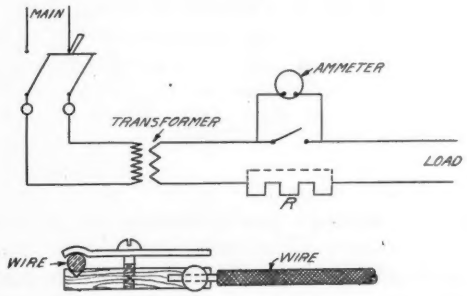
Try this in your power plant and in your home. Develop the proposition from every angle and see if you cannot benefit from these suggestions. So far as I am aware, no general knowledge of this method exists and it is my hope that you will be able to benefit very greatly from this publication of it.

Department of the Interior, Bureau of Mines, recently gave out the following list of new publications: Bulletin 123: Analyses of mine and car samples of coal collected in the fiscal years 1913 to 1916, by A. C. Fieldner and others, 1918. Technical Paper 91: A convenient multiple-unit calorimeter installation, by J. D. Davis and E. L. Wallace, 1918. Technical Paper 184: Weights of various coals, by S. B. Flagg, 1918. Technical Paper 189: Temperature-viscosity relations in the Ternary system $CaO—Al_2O_3—SiO$, by A. L. Field and P. H. Royster, 1918, 36 pp., 1 pl., 16 figs. Technical Paper 194: Report of the committee on the standardization of mining statistics, by A. H. Fay, 1918, 39 pp. Technical Paper 195: The tars distilled from bituminous coal in hand-fired furnaces, by S. H. Katz, 1918. Publications should be ordered by number and title. Applications should be addressed to the Director of the Bureau of Mines, Washington, D. C.

A Small Testing Device for Fuses

RECENTLY we had a proposition in our test department which called for the testing out of fuses. These were to be on a 24-hr. test, at full load. As we would have to test several thousand of these, the labor and time would be great; also the expense of loading up the fuses, as they would need lamp banks or resistances for load. The fuses would vary from 3 to 30 amp. It is easily seen that to load up to 30 amp., with variations, would need complicated wiring, etc.

In order to get away from this, we made up a small reducing transformer. This gave us a very low voltage, with high amperage. By inserting resistance in the circuit as marked at "R," we could vary the amperes by changing the resistance. We also placed an ammeter in the circuit with a short-circuiting switch, so that we could remove the meter from the circuit, thereby eliminating any possible damage to the instrument. The



SMALL TESTING DEVICE FOR FUSES

primary circuit was connected to the mains with a double-pole single-throw switch, and protected with fuses. The secondary was connected as follows: one side was fastened to a terminal on the base, the other was arranged with a movable clip so as to grip the wire in different places. This last point was worth considering, because, if the clip was moved from one side to the other, ½ turn of the secondary would be included, which varied the voltage, causing a difference in the reading of the ammeter.

This clip was nothing but the adoption of the old principle of the V notch. These two pieces were drilled and tapped to take a small machine screw so as to make it movable. As shown in the sketch, these were flat pieces of copper bar, with the V notch at one end and the wire connection at the other.

This device makes a portable testing outfit for making many numerous tests. This transformer was used on 110 v., but by changing the primary winding to correspond, it may be used on any voltage that is safe to handle.

DEAN B. COBB.

Using Loose Belts

ABOUT 10 yr. ago the writer gave, in the columns of this paper, a description of his belt practice, basing his observations on personal experience as well as that of others. Two of the drives illustrated are shown herewith, although somewhat changed, due to electrification of this plant.

The most important one was a two-ply 28-in. leather belt running over two 8-ft. pulleys. Owing to age and increasing load, it was necessary, several years ago, to add a new ply, the new ply being placed next to the pulleys.

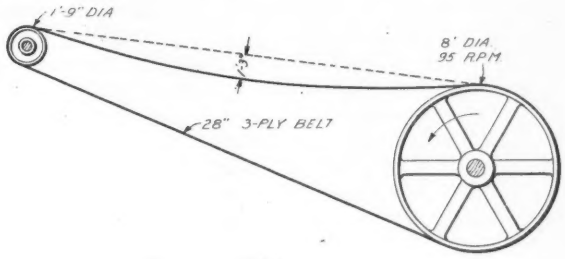


FIG. 1

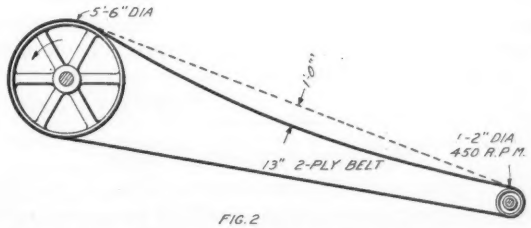


FIG. 2

FIG. 1. DRIVE EMPLOYING BELT WITH REINFORCING PLY
FIG. 2. DRIVE EMPLOYING 3-PLY 28-IN. BELT

The belt had a sag of about 4 ft. on 25-ft. centers and after replacement with about the same sag no trouble was experienced.

Less than a year ago we changed from shafting to electric drive, retaining the engine and installing a generator at about the place occupied by the former driven pulley in the rear of the engine, which ran under, placing the tight side of belt on bottom where it belonged. The engine speed was increased from 85 r.p.m. to 95 r.p.m. and owing to speed requirements the largest pulley we could use on the generator was 21 in. in diameter.

Centers were decreased to 23 ft. 6 in.; the belt, of course, needed shortening, but was left sufficiently slack to show a sag of from 15 to 18 in., according to the load.

We have carried at times over 1000 amp. without any trouble, this amount of current at 115 v. equaling 154 hp., and to this must be added the mechanical and electrical loss in the generator. For the sake of simplifying the calculations, I have assumed this to be 11 hp., which is not excessive. This makes a total of 165 hp. or 6 hp. per inch of width. Running at a speed of 2387 ft. per minute with an arc of contact on the small pulley of about 180 deg., I think it will be conceded that these are very good results. If the belt was tight, the arc would be considerably less and the strain on the bearings much greater.

Due to wear of the surface formerly in contact with the pulleys, the belt is now about equal in thickness to 2½ ply, somewhat heavy for a 21-in. pulley. The area in contact is about 4½ sq. ft.

Two plies of the belt are 19 yr. old and one ply 5 yr. (See Fig. 1.)

Another belt was a 14-in. two-ply running over 30 and 36-in. pulleys. Due to the change to motor drive, this was reduced in width to 13 in. and the center to center distance to 13 ft. The motor pulley is 14 in. and the driven one 5 ft. 6 in., the speed of the belt being 1482 ft. per minute.

A member of the firm viewing the change was skeptical about the belt doing the work, the driven machines requiring a heavy starting torque and requiring, when running, about 235 amp., or over 36 hp. To demonstrate the strength of the drive, I put both friction clutches in on the machines and started the motor, a 50-hp. machine, and the belt gave no trouble at all. This drive, as shown in Fig. 2, also has an arc of contact of about 180 deg., with about one foot of sag. Both sketches are drawn very nearly to scale and the degree of sag shown is not exaggerated.

There are a number of similar lighter drives in this place and most of them are in dusty places and are belts formerly used when power was transmitted by shafting. Positive proof as to the economy of slack belts is shown by the light belt and bearing maintenance costs.

HARRY H. YATES.

Standard Fire Brick Sizes

WE HAVE NOTED in your issue of Oct. 15 you give some practical tables for the benefit of your subscribers, some of which tables purport to show standard fire brick. We assume this information is particularly meant for the power plant engineer and think that the way it is gotten up will undoubtedly prove of value to such a man.

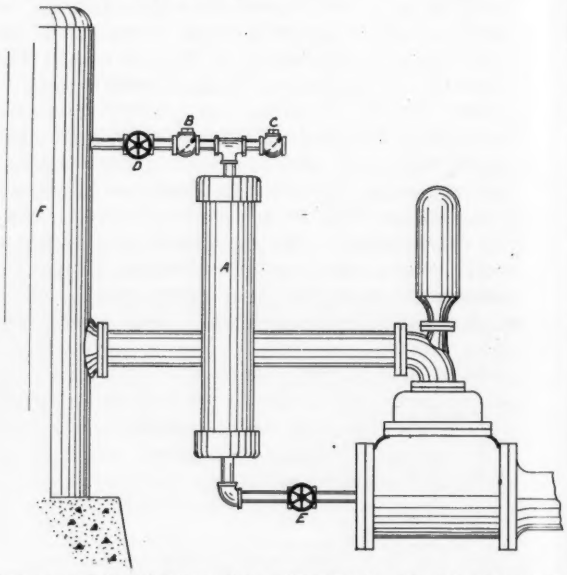
We believe, however, it is your intention to give correct information, as to be of any value, reference tables such as these brick dimensions should be accurate. With that idea in view, we wish to call your attention to the fact that your tables of fire brick dimensions are not the standard ones used by over 95 per cent of the fire brick manufacturers throughout the country.

We are enclosing our standard fire brick charts which give full cuts of standard fire brick with complete dimensions and with the correct names. These shapes and names have been adopted and are used by fire brick manufacturers of the country and we are endeavoring to get the fire brick users to order brick in accordance with these charts. EVENS & HOWARD FIRE BRICK CO.

[Information given on the charts which accompanied the above letter is published in the Reference Tables of this issue. The data given in the Oct. 15 issue was gathered from several sources which were considered authoritative, but were apparently not up to the most recent practice.—EDITOR.]

A Water Operated Air Pump

I NOTICE in Power Plant Engineering of Nov. 1 that J. E. M. is having trouble keeping enough air in the air chamber of his pump.



PIPING ARRANGEMENT FOR SUPPLYING AIR TO PRESSURE TANKS

The accompanying drawing shows an air pump operated by the water pump, several of which have been constructed by the writer for the purpose of supplying air to the pressure tanks of hydraulic elevators, but which could be applied to the air chamber of the water pump.

The drawing shows the device connected to an elevator pressure tank. *A* is a piece of 5 or 6-in. pipe capped on both ends, the caps being drilled and tapped for ¾ or 1-in. pipe as shown. *B* and *C* are check valves opening towards the pressure tank. The capacity of the pipe *A*, must be greater than the pump cylinder, for an 8½ by 12-in. pump, a piece of 6-in. pipe 3 ft. long will be sufficient.

The operation is as follows: With valves *D* and *E* open, a column of water will rise and fall in pipe *A*, with the motion of the pump piston. In falling, this water draws air through check valve *C*, when the pump piston reverses the water rises and forces the air into tank *F*, through check valve *B*. The capacity of *A* being greater than the pump cylinder, no air can enter the pump.

R. L. MOSSMAN.

Information Through a Little Excitement

WHILE OPERATING (although not knowingly) the engine described on page 795 of the Oct. 1, 1917, issue of Power Plant Engineering, I read the article entitled A Hot Bath, gave it careful consideration and filed the issue.

About two weeks later, I had a slight break-down on the steam valve mechanism and had to shut down. I checked the drafts and turned on the injector to back down the steam and set to work taking down the broken part. By this time, the manager and a grain buyer had stepped in to see what the trouble was. Shortly afterwards the source of water supply to the injector ran low and the injector blew through the overflow, which was located in the engine room.

The next thing we know the manager was making a hurried escape through an open window; of course the grain buyer and I had a laugh at the hurried departure.

After I got the piece repaired from the shop, I was busy assembling it with the grain buyer watching me, when suddenly the gage glass let go and he left as suddenly as did the manager. After I had shut the gage valves and the blowing of steam ceased, the grain buyer returned.

Then I had another laugh and asked: "Does a little thing like that scare you?"

"Well," he replied, "I have been scared of steam ever since I saw a fellow scalded to death back in Manitoba."

Upon getting a little more information from him, I said: "I read an article in Power Plant Engineering which is similar to your story." So I let him read the Hot Bath story, and he informed me that this was the very same engine. This began to be interesting to me and made me sit up and think and be more cautious than ever.

This engine is called "The Abell" and is located at Radisson, Saskatchewan, and was here when I took charge, 16 mo. ago; upon making inquiries I found out it had originally been at Headingly, Manitoba.

For the old "boat" heater an Ideal feed water heater has been substituted.

H. L. W. GNADT.

Cleaning and Sterilizing Well with Steam

STEAM generated by a locomotive was, after other methods failed, used successfully for cleaning and sterilizing a well located on the line of a railroad.

A steam ejector was screwed on the lower end of a pipe, lowered into the well casing and held with ropes, so that its lower end came within about 4 in. from the bottom of the well. A flexible hose fed the steam from the boiler to the ejector. As the steam was permitted to flow through the apparatus discharging the water, workmen stirred the bottom of the well with poles. Thereby the sand and mud which had accumulated was caused to rise and, together with considerable water, was ejected through the discharge pipe. The water was heated almost to boiling temperature. After the discharge had been operating for 3 hr. the water which flowed out became clear and clean, indicating that the job had been completed.

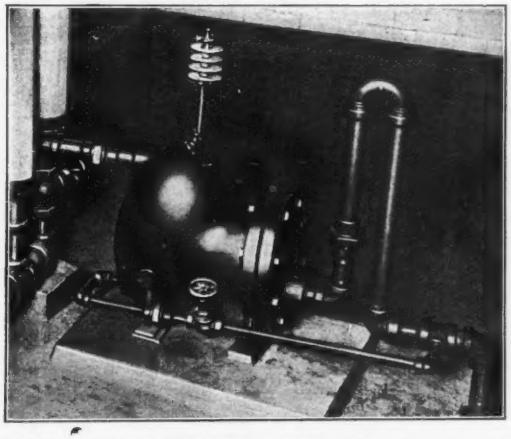
A previous attempt made to clean the well with steam from a pile driver was unsuccessful because of the relatively low steam pressure which its boiler developed.

MARK MEREDITH.

Answer to Trap Failure Question

WITH REFERENCE to the comment of Tom Thumb appearing on page 925 of the Nov. 15 issue, I would say that when a bucket trap or any other type trap is held open it is not functioning, but is wasting steam, a point which apparently caused our operating engineer friend originally to ask the question.

Bucket traps generally open wide and follow the water with a small slug of steam. Argue as you may, facts are facts, and if the discharge at equal rates flow from bucket and from float traps are collected separately in reservoir tanks, you will find that the water from bucket traps is much hotter than that from the constant flow float trap. A test on 100 gal. of condensation showing a difference of 34 deg. F.



A BYPASS ARRANGEMENT WHICH INSURES PROPER DISPOSAL OF SOLID AND FOREIGN MATTER AND SAVES STEAM

All reliable traps blowoff, regardless of type, but many bucket traps are so constructed that a slug of water carrying solid matter will jump the gap between body and bucket and deposit the solid matter in bucket; this is particularly so in some types where inlet is opposite the bucket hinge, and this side is very low when discharging, at which time, due to relief, there is the greatest flow to trap. The original question refers to a water-logged bucket which cannot be linked to sediment reached by blowoff; so stick to facts, and remember we are trying to help somebody out of trouble.

Bucket traps on pressures of over 60 lb. are bound to hammer, due to the high velocity, and therefore their maintenance cost is higher, a fact I go on record for, with all sincerity, after putting in 13 yr. of gas works superintendence, and carefully tabulating the operation expense of 16 different makes of traps.

I shall not enter into a discussion on levels; but it's lucky you never went to sea, for you would be horribly upset on a rough day when nothing on the ship except

the compass is level, and yet the traps among other things continue to function all right.

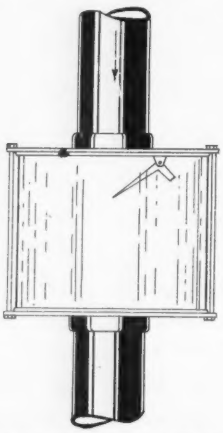
Regarding bypasses I hope the editor can see his way to publishing accompanying photo, as this form of by-pass is really helpful in that it gets rid of the solid and foreign matter without any mess on the floors and where open heaters are used, saves the steam which usually goes to waste.

Next time you take a bath, just take the plug out while the tub is full. Then let it down very slowly over the outlet and notice the pull and whang when it takes the seat—well, that is just what happens in a bucket trap. There is that whang at every dump, due to full travel and something eventually gives out, while the usual float trap keeps the valve nearer the seat, the valve only drawing away from seat as the float is elevated by incoming condensation, and again slowly closing as condensation is ejected, thus eliminating that slam and whang, or as in the Corliss or rotary valve type trap due to the sliding action of valve, closing gently without any whang or slam.

T. Haight.

Telltale on Cooling Water Connection

We had in service a large motor driven air compressor driven at a heavy load and consequently the matter of supplying the machine with plenty of jacket cooling



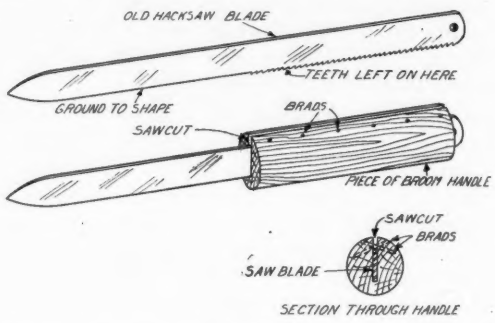
DEVICE TO INDICATE FLOW OF WATER

water was of great importance. The water was pumped from a small stream outside the plant and on several occasions the compressor was dangerously overheated because the cooling water supply failed due to the stopping of the pump and clogging of the suction intake and the operator in the compressor room was not aware of the failure of the supply until the heating occurred as the pipe system was closed. We decided to put a telltale on the line which would show at a glance whether any cooling water was flowing. To accomplish this, we made use of an old sight feed glass about 4 in. in diameter and suspended in it near the inlet a small metal arm which extended out into the flow, as shown in the sketch. This arm was weighted so that with no flow it hung horizontal, while any flow through the pipe tended to force the long arm, resting in the flow, further and further down so that the compressor man could tell at a glance whether or not a supply of water was flowing through the pipe, and by the position of the arm he could tell whether the flow was light or heavy.

M. A. Saller.

A Readily Made Gasket Knife

There is no excuse for the engineer's force not to be plentifully supplied with handy gasket knives or knives for scraping, etc., for there is always in hand a supply of broken or worn out hack saw blades and a few



METHOD OF UTILIZING HACK SAW BLADE AS A GASKET KNIFE

old broom handles. These are all that are needed. The sketches show the way to make them, and one can make up a bunch in a little while. C. H. Willey.

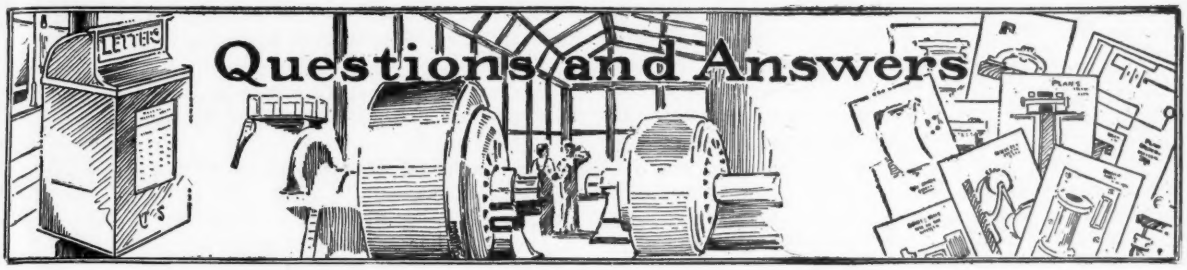
Why Iron Chimneys Corrode

The cause of corrosion of galvanized-iron extensions to chimneys is laid generally to condensation which forms inside the stack, and which, in conjunction with the carbon deposited in use, creates a galvanic action which soon destroys the zinc coating and finally eats through the iron or steel base. To prevent the condensation, an air space around the stack is recommended. The stack is made double from the base to a point close to the top, with small iron braces between the inner and outer castings. These may be riveted close to the ends of the sheets in course of construction. The air space may be 1 or 2 in., according to the size of smokestack and local conditions.

Mark Meredith.

Washing Steam Boilers

Some time ago, I saw an article in Power Plant Engineering on washing the tubes of boilers with water. I claim this is the only way to clean tubes in water-tube boilers, as you can get with a stream of water where you can not get with steam. It is also safer for the man doing the work, for the worst he gets is a good bath. I would not do this if the boiler is very warm, because it is bad for the brick work. I have been doing this same thing for over 5 yr. and find no bad effects so far; but our boilers are down at least a month before cleaning, as we wash only once a month and wash with cold water from city pressure at about 80 lb. This cleans them fine; the setting is just warm enough to dry well and no sign of rust. A. E. Worth.



Burning Shavings Under Marine Boilers

CAN ANY of the readers of Power Plant Engineering tell me of a method of firing sawdust and shavings in a marine boiler without making smoke? There are two plants in my city, the one at which I am employed and another in the north end, and both use single furnace marine boilers and make lots of black smoke.

The draft is so strong it pulls the ash pit doors shut. I have seen sawdust and shavings leave the top of the 75-ft. stack. All I run from this boiler is a 150-hp. Murray Corliss engine and a boiler feed pump.

R. G. S.

Rear Settling Space

IN REPLY to the inquiry of W. K. appearing on page 937 of the Nov. 15 issue, I would state that the reduction in space he purposes employing may not seriously impair his draft, but before making the proposed changes, he should consider the fact that some day either he or someone else may want to get back there for the purpose of rolling or calking tubes.

H. BAUGENMACHER.

Why the Pound?

I HAVE NOTED with considerable interest the statement of C. W. A. regarding his trouble with pounding in his feed lines, which is made doubly mysterious because he states that the pump and line are plenty large enough, and the pump is provided with an air chamber.

It seems to me that the trouble is due to either one of two causes, both resulting partially from the circuitous piping through which the feed passes. The running of the feed line in the manner shown makes it easy for air or steam vapor pockets to form in the line, and I believe investigation will show that the pounding is due to this cause. The air can find its way into the feed lines through the water, first taken from the receiver, and then an additional amount of air can be released due to the heating action in the heater. This air will pocket itself in the line and cause pounding as the water is forced through the line by the pump. Some of the air can be released by providing an ample size vent on the receiver so that the air brought back with the returns can readily escape; in other words, the receiver should also be made to act as an air separating tank. The air driven out of the water due to its heating in the heater is difficult to get rid of, unless an open type heater be installed.

Then again the binding on the pipes may be due to steam which can find its way back into the feed line because of leaky or defective check valves.

The remedy, therefore, for C. W. A.'s trouble, as I see it, is to re-arrange the feed piping so that it does not invite the formation of air and steam pockets; that arrangements be made for ridding the water of the air entrained with it, and that the check valves on the feed lines be examined to make sure that they are not leaking.

M. A. SALLER.

THE TROUBLE referred to in my letter appearing on page 936 of the Nov. 15 issue has, since writing, been largely overcome as the result of a good deal of experimenting.

The desired result was obtained by tapping into the ell nearest the pump on suction and attaching by means of the necessary nipples a 1/8-in. angle valve and a ball check valve of like size. By regulating with the angle valve a certain amount of air is taken in; the colder the water, the greater the amount of air required.

This scheme has worked entirely satisfactorily and there is hardly a bit of noise anywhere in the pipe line.

C. W. ALDEN.

I FAIL TO SEE why C. W. A. should run the feed line across the top of both boilers and around the front of each and then up over the top again. It is quite obvious there could be no reason why he could not have the feed line drop down from his heater and extend across to the center of his boilers with a branch up to the right to the inlet of each boiler instead. Probably that would relieve the situation and would be more practical, unless he has no proper vent on the receiver. In that case, the pump would "kick" at times on account of getting the feed water at a higher temperature than practicable.

JAMES G. SHERIDAN.

Condenser Questions

IN THE CASE of a surface condenser which can readily be shut down for the purpose, how could you detect leaks?

2. How would you determine the proper size of condenser to use with an engine if given dimensions or rated capacity?

F. P.

ANSWERS

IF, AS YOU SAY, it is possible to shut down the condenser, then a leakage test may readily be made by removing the two end heads of the shell and placing the inside of the condenser under a hydrostatic pressure. Any leakage which may exist will very readily show up at the ends of the tubes where they enter the end plates.

2. The proportions of a jet condenser are relatively unimportant, the design merely providing for adequate mixture of water and steam. The shell, therefore, need only be large enough to take the exhaust and water connections. The volume of jet condensers varies from 0.5 to 2.5 times the volume of the low-pressure cylinder of a reciprocating engine. In the eductor type, the volume is somewhat less.

Surface condensers are limited in capacity by the rate of heat transfer. For average practice, 300 to 350 B.t.u. per square foot, per degree mean temperature difference per hour can be allowed. It follows from this assumption that,

$$A = W \frac{(H_2 - q_3)}{U \times t_n}$$

Where A is the area, in square feet, of tube surface;
W is the pounds of steam per hour from exhaust;
H_2 is the total heat per pound of exhaust;
q_3 = 1000 to 1050 for most cases;
U = transmission co-efficient = 300 to 350 B.t.u. per hour, per square foot, per degree temperature difference;
t_n is the mean temperature difference between the steam and circulating water.

Calculating Boiler Heating Surfaces

ON PAGE 857 of the Oct. 15 issue of Power Plant Engineering, F. P. inquires how to determine the heating surface of a boiler; while the answer given serves the purpose, it does not go into the matter as broadly as the subject warrants.

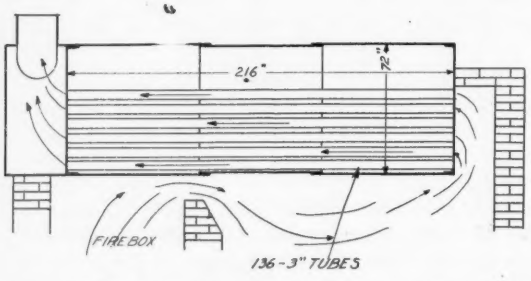


FIG. 1. SECTION OF A TYPICAL RETURN TUBULAR BOILER

In a horizontal tubular boiler, Fig. 1, the heating surface is equal to the sum of ½ the product of the length times the circumference of the shell, plus ⅔ the area of the rear head minus the combined tube openings plus the combined internal area of all the tubes. The front head is not considered, as that is in reality not a heating surface.

With the data given in Fig. 1, we have that portion of the surface of the shell considered as a heating surface equal to half the product of 3.1416, 72 and 216, or 24,429.08 sq. in.

Multiplying the square of 72 or 5184 by 0.7854 we obtain 4071.51 sq. in., or the area of the rear head. From this, however, must be subtracted the area of the tube openings, which is equal to 136 times the square of 3 times 0.7854 or 961.32 sq. in., thus leaving an effective area of ⅔ of 4071.51 minus 961.32, or 1753.00 sq. in.

Each tube has an effective heating surface of 3.1416 times 3 times 216, or 2035.75 sq. in., or a total of 276,862 sq. in.

The total heating surface then is equal to the sum of 24,429.08, 1753 and 276,862 sq. in., or 303,044.08 sq. in., or 2104.47 sq. ft.

In a boiler of this type, 12 sq. ft. of heating surface is allowed for each horsepower, so that on such a basis the horsepower rating would be equal to 2104.47 divided by 12, or 175.37.

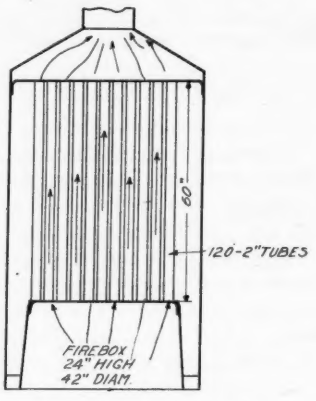


FIG. 2. VERTICAL TUBULAR BOILER

In the vertical tubular boiler, Fig. 2, the heating surface consists of the side wall of the fire box (less the area of the fire door opening), the lower tube sheet (less the combined area of the tube openings) and the internal surfaces of all the tubes. Due to the fact that the hot gases do not impinge against or come in direct contact with that part, the upper tube sheet is not taken into consideration.

From the data given, we find that part of the fire box wall effective as heating surface equal to the product of 3.1416, 42 and 24, minus 12 times 12, or 3022.73 sq. in. Multiplying the square of 42 by 0.7854 and subtracting from this the product of 120, 4 and 0.7854, we obtain 1008.45 as the effective area of the lower tube sheet.

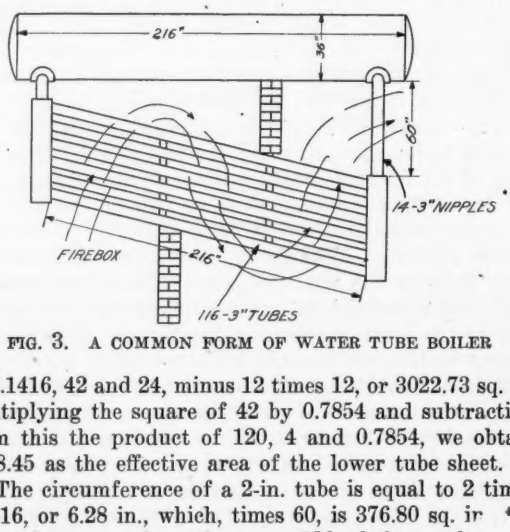


FIG. 3. A COMMON FORM OF WATER TUBE BOILER

The circumference of a 2-in. tube is equal to 2 times 3.1416, or 6.28 in., which, times 60, is 376.80 sq. in. the internal area; and, as there are 120 of these tubes, the total heating surface of all the tubes is equal to 120 times 376.80, or 45,216 sq. in.

The total heating surface of this boiler is equal to the sum of 3022.73, 1008.45 and 45,216, or 49,247.18 sq. in. or 342 sq. ft. As 14 sq. ft. of heating surface in this type of boiler is allowed for each horsepower, the rating of this boiler would be 342 divided by 14 or 24.5 hp.

As there are so many forms of water-tube boilers upon the market, that part of the external surface which may be considered as the heating surface depends upon the particular make or form of boiler under consideration. In general, however, it may be said that the heating surface consists of half the shell plate area of the drums, all of the external area of the tubes and the external area of the connecting nipples where such nipples are used and are in the path of the hot gases. In boilers the Edge Moor, Heine or Keeler type, there is also considerable heating surface in the back face of the headers.

Referring to Fig. 3 and using the data given, we have the following problem. Half the drum sheet area is equal to one-half the product of 3.1416, 36 and 216 or 12,228.84 sq. in.

The heating surface due to the tube area is equal to 3.1416 times 3 times 216 times 116, or 236,027.52 sq. in.

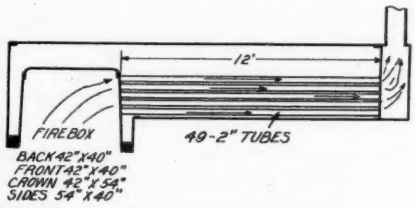


FIG. 4. ARRANGEMENT EMPLOYED IN THE LOCOMOTIVE BOILER

The fourteen 3-in. nipples having a length of 60 in., offer a heating surface of 7912.80 sq. in., which, added to the sum of the above values, provides a total of 256,169.16 sq. in., or 1778.1 sq. ft.

Allowing 10 sq. ft. of heating surface for each horsepower, we have a rating of 177.81 hp.

In boilers of this type, care must be exercised in order to secure accurate results, to ascertain just what amount of heating surface is cut off by baffling.

In boilers of the locomotive type, the heating surface involves the inside area of the fire box (less tube and fire door openings) internal area of all tubes and three-fourths area of rear head (less tube openings).

With the data given, we find the internal surfaces of the fire box equal to the area of the two sides or 4320 sq. in. plus the area of the crown sheet or 2268 sq. in., plus the areas of the front and back sheets (less door and tube openings) or 2873 sq. in., giving a total of 9461 sq. in.

Each tube offers 1184.4 sq. in. of heating surface so that the entire effective area of the tubes is equal to 58,035.2 sq. in.

Two-thirds the area of the head less tube openings is equal to 1014.2 sq. in., thus making a total of this amount plus 58,035.2 plus 9461, or 68,510.4 sq. in., or 475 sq. ft.

This divided by 10 (the number of square feet allowed for each horsepower) gives a rating of 47.5 hp.

In calculating the heating surface of any boiler, it must be remembered that the true heating surface is that surface which has water on one side and heat on the other.

A. D. PALMER.

Operating Clocks on High Voltage

WE HAVE a system of time recording clocks handled by 18-v. batteries; one set carries the clocks while the other is being charged by our 110-v. direct-current machine.

What I would like to do is to have the generator carry the clocks during the day so as to save the batteries for night and Sunday service.

How would you advise cutting machine voltage down to 18 v.? If with lamp, how many would I be required to use? J. S.

A. In regard to your proposal to try to operate your recording clocks on the 110-v. generator by inserting resistance, our advice on this point would be, don't try it. The mechanism of the recording clocks is quite delicate, and variation in voltage is likely to make trouble.

The only form of resistance which you can introduce would be a bank of lamps, and we could not tell you what to use without knowing what current is taken by the clock circuit. We do know that this is very small, and it would take a very high resistance to reduce from 110 to 18 v. by means of a lamp bank.

The resistance of lamps varies with the temperature of the filaments, and this would vary widely with a slight change in the current on the clock circuit. This would make a change in voltage on the recording apparatus, and that would be likely to disarrange the whole operation of the recording system.

Thickness of Wrought Iron Pipe

WHAT IS the wall thickness of 6-in. standard wrought iron pipe and that of 6-in. double extra heavy wrought iron pipe?

How do you calculate the bursting pressure of pipe? W. C. H.

A. The wall thickness of standard 6-in. wrought iron pipe is 0.28 in. while double extra heavy wrought iron pipe of like diameter has a wall thickness of 0.864 in.

The bursting pressure of pipe of given wall thickness is equal to the quotient obtained by dividing the product of twice the thickness in inches, and the tensile strength of the material by the internal diameter of the pipe in inches.

To determine the working pressure, divide by a suitable factor of safety which may be assumed as 6 or 8.

IT IS understood that the Emergency Power Bill which had passed the House and was being revised by the Senate will be dropped and no further effort made to enact it.

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Americanization—A Duty

Always it has been a duty, as well as a matter of self-interest, for our country to amalgamate and weld into one nation those of various races and languages who come to our shores.

Frequently neglected, always in unrelated and haphazard ways this duty has been poorly attended to. And much of our difficulty from social unrest and radical agitation has resulted from the failure of those who have come to us from other lands to understand our government, what it offers to its citizens besides a chance to make a living, and the difference between liberty and lawlessness.

One of the first steps is a knowledge of the English language, and many companies are establishing classes for workers to meet this need. The foreign-born should be urged to take advantage of such opportunities and assist, not only in class work, but in daily occupation to make progress.

A second need is friendliness; and this can best be met by the attitude of fellow workers in the plant and on the street. The language that a man learned in his childhood has nothing to do with his manliness, and his handling of English is no different from what your performance would be if you went to Serbia or Italy and tried to absorb and use their language. Be friendly.

As a third advance, comes the absorbing of the spirit of America. Our men and women of foreign birth have proved their loyalty in no uncertain ways. It is for us to show by example and to promote by comversation the appreciation of the principles for which we have fought; the working together for the common good which is the foundation of democracy; the opportunity for each one to make the most of his abilities, both to secure the comforts of living and to contribute to the advancement of humanity; the rights and duties of citizenship with understanding of every citizen's responsibility and privilege in choosing the officials who administer his government and expressing his will as to their course of action.

The first step is the most important at present; to teach a working knowledge of English, both speaking and reading, to every person residing in the United States. No loyal American should overlook his responsibility in this regard while at the same time carrying the spirit of friendliness to his co-workers.

Estimating Salvage Value

With the close of hostilities, a period opens which will include many changes in power plants which have been held back by the necessity of winning the war. Efficiency in production will be demanded wherever possible. In many installations sweeping changes in equipment will be required, while in others, of course, few if any immediate modifications will be necessary. We do not mean that a general overturn of existing practice and apparatus is at hand, but that it will be essential to take up the problem of plant economy afresh and to analyze betterment possibilities with a thoroughness which in many instances was out of the question under

the stress of war conditions. The existing high cost of fuel and the small prospect of any early reduction in its price to a point even within hailing distance of pre-war figures, impose a heavy responsibility upon the plant operator and owner to do away with wasteful methods.

It will not be long before the manufacturers of power plant machinery will be accepting orders for new equipment as formerly and an important phase of the betterment problems in the operating station will be the salvage value of the equipment which is to be replaced. Whoever has charge of the betterment determination, so to speak, must inform himself of this point. As the operating engineer knows, or should know, this equipment better than anybody else, it is desirable that he should form a thoroughly professional opinion as to its salvage value. This opinion may be called for or not; but a readiness to advise on this point is a measure of preparedness which the far-sighted engineer will not neglect. As a matter of trade, it goes without saying that the plant owner and engineer alike naturally stand in favor of obtaining the highest possible price for equipment which honorable dealing permits; but apart from this, it is important to determine, at least approximately a sort of base value which will represent the minimum below which it will not pay to go in disposing of such machinery.

Various data may be secured along this line which the operating engineer should find helpful. These include the unit costs of machinery of equivalent capacity new; the unit selling price of similar apparatus sold at secondhand during the past few years; the junk value of corresponding equipment; the possibility of utilizing the machinery in another installation; and the cost of repairs or readjustments which will enable the old machinery to remain at its post for a stated period. In the files of many of the state public utility commissions can be found equipment prices which will be helpful to the engineer making up a data book of unit costs new and installed. These files are open to public scrutiny and if the engineer has access to them he will find more or less data of interest tabulated in connection with the issue of securities, where such securities are issued under the approval of the commission. Approximate prices of equivalent machinery may readily be obtained from manufacturers' representatives, but in securing them it is well to be perfectly frank about the purpose of the engineer and it is not necessary to obtain rock-bottom bids to meet the situation from the standpoint of salvage analysis. The initial cost of the equipment under discussion and the sum total of repairs upon it ought to be available from the accounting department of the plant-owning organization. Finally, the economic efficiency of the equipment is a factor which should be looked into, and where tests of performance are available, so much the better, especially if the tests show efficiency today as compared with a former period. From a consideration of points like the foregoing, the engineer can form his own opinion as to the value of the equipment when removed from service, and even if he cannot obtain this price in the sale, or if he obtains a better price, his judgment as to the salvage value will be far better than a mere guess and as such will be worth while from the standpoint of himself and of his superiors.

Coal Ups and Downs

During September the increase in coal output at the mines over 1917 made it seem probable that serious shortage this winter would be avoided, although, to make the coal go around for industrial and domestic use, would require the strictest economy and careful management.

Since the week of Sept. 28, however, there has been a steady decline in the weekly coal production, and for the week of Nov. 2 it was but little above the corresponding week of 1917. Unless production increases, quickly and largely, the probability of a shortage will again be present.

The falling off is in both anthracite and bituminous. For anthracite, the production for 1918 up to Nov. 2 has been 251,000 T. less than for the like period in 1917, so that there is no chance for any increase allotment of anthracite to any district. In fact, it is doubtful if any districts, except those nearest the mines, get the full amount of anthracite already alloted to them, on account of transportation difficulties.

Report of the geological survey attributes the slowing down in production to the influenza epidemic, and to continued warm weather which has reduced the industrial demand and transportation activity. Reports show that the car shortage, labor shortage and no-market losses of capacity have increased materially since the beginning of October, the no-market cause being chiefly in southwestern and Pacific coast districts.

The lesson for power plant executives is to guard against any feeling of security as to fuel supply, for, until the cold weather of the coming winter is past, the likelihood of a fuel shortage will be ever present, and every possible precaution should be taken to guard against it, by keeping on hand as much coal in storage as the Fuel Administration permits, and striving for every possible economy in the use of fuel.

ANY DISABLED soldier or sailor who could follow his old occupation but feels the need of more training may secure instruction from the Federal Board for Vocational Education. This board believes that it is the duty of the Government to help such men to realize their full capacities and training may be necessary to accomplish this end with a disabled man. Such men are entitled to all the training necessary to fit them to compete successfully with a normal workman under normal conditions. This means training of the head as well as the hands in order that they, with their handicap, may meet competition successfully, get a steady job and win promotion.

THE VOLUME of natural gas from which the output of natural-gas gasoline in 1917 was recovered is estimated to have amounted to about 429,000,000,000 cu. ft., and the average recovery of gasoline per thousand cubic feet was about one-half gallon.

Successful Burner for Fuel Oil

IN ORDER to prevent a recurrence of the fuel conditions of last winter, much study is being given to the fuel situation. One of the suggested means for relief is the more extensive use of fuel oil, particularly in those sections of the country where it can be easily and cheaply obtained. The use of this fuel has many advantages, such as simplicity in handling convenience, efficiency, and in many localities it is cheaper than coal.

To burn fuel oil, it must be perfectly atomized, and at the same time sufficient air must be introduced to get thorough combustion. W. S. Ray, of San Francisco, has devised a method of atomizing oil in an open cup, lying horizontally, driven at 3450 r.p.m. and then forcing air at high velocity around the cup and in a direction

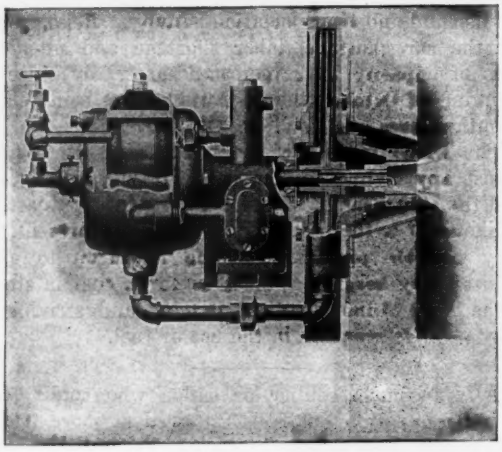

FIG. 1. SECTIONAL VIEW OF BURNER

away from the cup. In this method he not only introduces sufficient air for proper combustion but also enough to direct the fire into the fire-box. Naturally, the air leaving the blower would be turning in the same direction as the atomizer, causing the fire to be unsteady, and having a tendency to throw oil on all sides of the fire-box, but this the inventor overcomes by inserting guide vanes in a nozzle surrounding the atomizer, which direct the air from a revolving motion to a straight path.

This method has been found to give perfect combustion of the oil, and the inventor has developed a burner to utilize it with as little complication as possible.

So necessary is the oil burner to the institution in which it is used, that no excuse will be accepted for its being out of commission at any time. Therefore, it must be constructed of the best material, and all parts must be interchanged and of well-known standards.

The Ray oil burner employs a Westinghouse totally enclosed motor. The hollow shaft of this motor has been extended to permit the worm gear to be fastened to the center of the shaft, and the blower and atomizer are attached to the end opposite the motor. This permits the centering of the bearing on the shaft. A ball bearing is used at each side of the worm gear. This worm gear is encased in a housing which is constructed with an oil well at the base. This gives the two bearings a splash

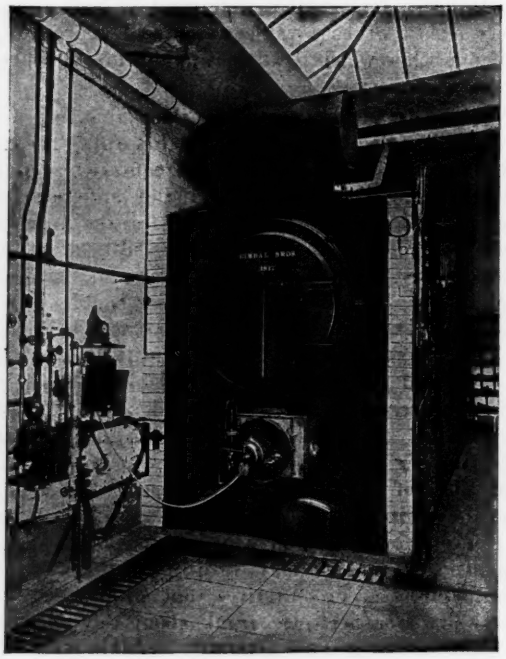

FIG. 2. INSTALLATION WITH 150-HP. BOILER IN GIMBAL CANDY FACTORY

feed which is positive and removes the danger of either under-oiling or over-oiling.

With the exception of domestic stoves, fuel oil as low as 14 gravity can be burned successfully without smoke, soot or dirt, in all types of fire boxes, where high heat is needed.

In addition to a saving in the cost of fuel, there is an additional saving in the cost of attendance. To burn coal requires attendants constantly on the job 24 hr. a day, whereas one man can supervise a large number

of oil burners. This feature is well worth consideration, not only from a monetary standpoint, but also from the standpoint of the labor supply.

The Ray oil burner is very flexible in its application and can be used in anything from a hot-air furnace in a private residence to a 500-hp. boiler installation.

Anchoring the Anchor Bolts

IT is unnecessary to emphasize to practical men the absolute necessity of firmly securing bed plates and bearing pedestals to their foundations. The modern high-speed engine requires particular attention in this respect as the forces tending to loosen the bolts increase with the square of the r.p.m. In the case of generators, the electrical effect or even a slight shift in the alinement of the armature or rotor, with consequent variation in the airgap, must be considered.

Many engineers have found that concrete foundations, particularly when much oil is present, tend to disintegrate under vibration sufficiently to loosen the anchor bolts. For this reason they always set their bolts in Smooth-On Iron Cement No. 7, which is mixed with water to the consistency of stiff putty. The holes to receive the Smooth-On and bolts can be sunk after the concrete is set, or the forms can be made to include them.

The Smooth-On and bolts should be put in immediately before placing the bed plate or pedestal, so that the bolts can be accurately positioned before the Smooth-On sets. After the Smooth-On sets the bolts are drawn tight. This gives a perfectly solid anchorage without any chance of straining or warping the bed plate. The Smooth-On expands as it metallizes and insures a permanently tight anchorage.

Smooth-On Iron Cement No. 7, mixed with 4 parts of Portland cement, 3 parts of sand and 2 parts of grits, is widely used for making engine foundations. It oilproofs the concrete and gives it additional strength and life.

New Commutator Surfacing Device

A NEW way of keeping a perfect surface on commutators has been developed by the Ideal Commutator Dresser Co., 8 South Dearborn St., Chicago. Instead of shutting down the motor or generator, taking out the commutator and turning down in a lathe this method permits of keeping the equipment in constant use, as the commutator does not need to be removed. The electrical equipment does not even need to be stopped as the work is done with the commutator running under the usual load.

An abrasive material has been prepared, which for convenience is mounted in block form on a handle. This block of abrasive material is held against the revolving commutator, so that all high spots, high mica and other imperfections in the commutator surface are cut down, leaving a perfect surface. This abrasive material is non-metallic and does not collect copper or cause consequent short-circuiting. It will not fill up or wear smooth but cuts quickly, evenly and with but a slight expenditure of time and effort.

Commutators can be kept in good condition in this way by occasional applications of this abrasive block, called the "Ideal" Commutator Resurfacer. When commutators are always held in good condition, sparking and consequent power losses are held at a minimum. This resurfacer is made in a variety of styles and sizes for use on any commutator. Coarse, fine and extra fine grades are manufactured. The coarse grade is used on comparatively heavy work, fine grade is used for smoothing down and the extra fine grade is used for polishing where a particularly good surface is wanted.

Little Giant Corner Drills

THE Little Giant Corner or Close Quarter Drill, manufactured by the Chicago Pneumatic Tool Co., Chicago, was designed to overcome the objection arising from the intermittent action of ratchet levers in the rotation of the spindle. In the Little Giant, steady, uninterrupted revolution of the drill spindle is accomplished by means of a train of gears, retaining all the advantages of the ratchet type and permitting the drill to be used in the same narrow space, within 1 7/16 in. of the end wall or corner.

AIR DRILLS FOR CLOSE QUARTERS

In the Little Giant corner drill, the power of the motor is transmitted to the spindle without vibration, resulting in a steady, even pull with minimum wear and tear on the machine itself.

In the stub tooth gears, which are employed, the root of the gear tooth is much thicker than in the standard involute tooth. The tooth itself is shorter, hence it has a harder pull, and special alloy steel is used in these gears.

SPECIFICATIONS for pipe line and penstock for Power Plant No. 2 in the San Francisquito Canyon to cost $50,000 to $100,000, have been submitted to the Public Service Commission of California by Engineer Scattergood, of the Los Angeles Bureau of Power and Light, but have not yet been acted upon.

Mason Condensation Meter

ONE OF the most recently perfected pieces of apparatus designed for the accurate measurement of steam condensation or other liquor, and capable of measuring vapor to a maximum pressure of about 5 oz., regardless of temperature and with varying gravity, is the Mason Condensation Meter, manufactured by the Plant Engineering & Equipment Co., Inc., New York City.

This meter is a device for recording the operating cost of steam consuming devices such as employed for special manufacturing processes, atmospheric and vapor heating systems or where steam is sold from a central station to consumers, or from a main boiler room to building tenants, and which must be determined by accurate measurement of the discharged condensate.

Essentially, as shown in the accompanying illustrations, the meter consists of a cast-iron housing supported by tripod arrangement of adjustable legs, to which the returns to be measured are piped. The return condensation enters the vapor condensing and equalizing chamber at the top, then discharges into an aluminum dumping bucket, which, through the medium of a counter, operates an integrator set in a vapor-proof recess in the front of casing.

The condensate flows through the equalizing chamber to one side of the bucket, which when filled overbalances the empty side of the bucket and automatically

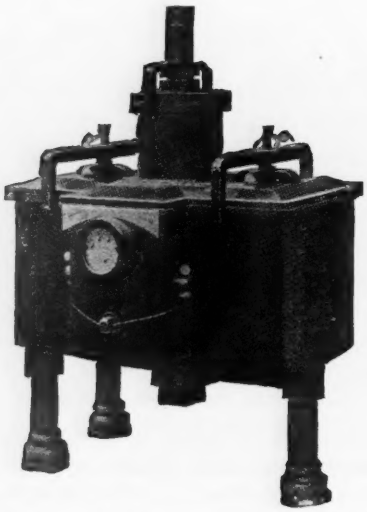

FIG. 1. THE MASON CONDENSATION METER

dumps, bringing the previously empty side under the filling slot, an alternate action accompanied by a movement of the counter and the registering dial, which is graduated to read direct in pounds of condensation passed.

Lugs on each side of the projection of the casing carrying the integrator allow for the adjustment of the aluminum dumping bucket, the travel of which is limited by means of a bronze shock-absorbing cap slipped over a projection to the bucket shaft, as shown in Fig. 2.

Any sediment which might accumulate within the condensing and equalizing chamber may be removed by taking off the cover of the chamber, which is easily accessible. Ample space is provided in body of meter to allow accumulations of solid or foreign matter without interfering with its action, although the condensation to be measured generally being the discharge from steam traps, there is little chance of foreign matter being carried over.

This meter, like any other, will give best results on

FIG. 2. SECTION OF THE MASON CONDENSATION METER

a constant or reasonably uniform flow of condensation, and preferably float-controlled constant flow steam traps should be used therewith.

Eastern New York Power Companies Made Coal-Saving Record

COAL saving at the rate of 5000 tons a month has been effected by six power companies of Eastern New York through the operation of a plan of joint operation and the use of water power heretofore wasted, undertaken at the suggestion of the Fuel Administration. This record in coal conservation was effected without a change in existing equipment or additional cost to the power companies, and the success of the plan has been so marked that the companies interested are anxious to continue it.

The companies which combined and carried out the plan through a joint committee made up of their regular organizations, serve what is known as the "Capital District," including the cities and towns of Albany, Troy, Schenectady, Amsterdam, Mechanicsville, Cohoes, Saratoga, Glens Falls, and adjacent territory. In the hands of the joint operating committee and using the available resources of the six power companies a two weeks' test was begun on Oct. 23. In that period electric energy equal to that generated by the burning of 2450 tons of coal was developed from existing equipment, and the natural river flow which otherwise would have gone to waste. The generating companies were thus

These tables contain data especially worked out or carefully selected that are vital to your work. You may need them at any time and should preserve them. A handy, serviceable, loose-leaf cover in which these tables fit exactly, will be sent you for 30 cents in currency or stamps.

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POWER PLANT ENGINEERING

TABLE I. COMPOSITION OF BEARING METALS

No. of Metal	Per Cent of Constituents			
	Copper	Tin	Antimony	Lead
1	4.5	91.0	4.5	----
2	3.5	89.0	7.5	----
3	8.33-1/3	83.33-1/3	8.33-1/3	----
4	3.0	75.0	12.0	10.0
5	2.0	65.0	15.0	18.0
6	1.5	20.0	15.0	63.5
7	---	10.0	15.0	75.0
8	---	5.0	15.0	80.0
9	---	5.0	10.0	85.0
10	---	2.0	15.0	83.0
11	---	---	15.0	85.0
12	---	---	10.0	90.0

POWER PLANT ENGINEERING

AMOUNTS OF DIFFERENT FUELS FOR EQUAL HEAT VALUES

Figured on basis of
Coal 12,000 B. T. U. per pound
Oil 144,000 B. T. U. per U. S. gallon
Natural gas 1,000 B. T. U. per cubic foot
Coal gas, 625 B. T. U. per cubic foot
Coke oven gas 592 B. T. U. per cubic foot
Bituminous producer gas 146 B. T. U. per cubic foot
Anthracite producer gas 139 B. T. U. per cubic foot
—Tate-Jones & Co.

Oil Gallon	Coal Pounds	Natural Gas Cubic Feet	Coal Gas Cubic Feet	Coke Oven Gas Cubic Feet	Bituminous Producer Gas Cubic Feet	Anthracite Producer Gas Cubic Feet	Total B. T. U.
1.	12	144	230	243	995	1035	144,000
167	2000	24000	38400	40000	166000	173000	24,000,000
6 93	83 3	1000	1600	1666	6930	7180	1,000,000
4 34	58 1	693	1000	1053	4380	4550	693,000
4 1	49 3	589	943	1000	4039	4200	592,000
1 02	12 2	146	235	248	1000	1053	146,000
.97	11.6	139	222	234	948	1000	139,000

POWER PLANT ENGINEERING

STANDARD FIRE BRICK

9" STRAIGHT
9" x 4½" x 2½"
SMALL 9" BRICK
9" x 3½" x 2½"
SPLIT BRICK
9" x 4½" x 1½"
SOAP
9" x 2½" x 2½"
CHECKER
9" x 2½" x 2½"
2" BRICK
9" x 4½" x 2"
NO. 1 WEDGE
9" x 4½" x (2½" — 1⅞")
NO. 2 WEDGE
9" x 4½" x (2½" — 1½")
NO. 1 KEY
9" x (4½" — 4") x 2½"
NO. 2 KEY
9" x (4½" — 3½") x 2½"
NO. 3 KEY
9" x (4½" — 3") x 2½"
NO. 4 KEY
9" x (4½" — 2½") x 2½"
NO. 1 NECK
9" x 4½" x 3½" x 2½" x ½"
NO. 2 NECK
9" x 4½" x 2½" x 1½" x ½"
NO. 3 NECK
9" x 4½" x (2½" — ½")

POWER PLANT ENGINEERING

STANDARD FIRE BRICK

9" x 6" x 2½" STRAIGHT
ALSO 9" x 6" x 3"
9" x 6" No. 1 KEY
FOR 13' CIRCLE INSIDE DIAMETER
91 BRICK TO THE CIRCLE
9" x (6" — 5⅜") x 2½"
ALSO 9" x (6" — 5⅜") x 3"
9" x 6" No. 2 KEY
FOR 8' CIRCLE INSIDE DIAMETER
47 BRICK TO THE CIRCLE
9" x (6" — 4⅛") x 2½"
ALSO 9" x (6" — 4⅛") x 3"
LARGE 9"
9" x 6½" x 2½"
LARGE 9" No. 1 WEDGE
9" x 6½" x (2½" — 1⅞")
LARGE 9" No. 2 WEDGE
9" x 6½" x (2½" — 1⅛")
CUPOLA BLOCKS
(9" —) x 6" x 3"
ALSO (9" —) x 6" x 4"
CUPOLA BLOCKS
(9" —) x 9" x 4½"
9" ROTARY KILN BLOCKS
(9" —) x 9" x 4"

NO. OF BLOCK	DIAMETER INSIDE	DIAMETER OUTSIDE
30	30"	42"
36	36"	48"
42	42"	54"
48	48"	60"
54	54"	66"
60	60"	72"
66	66"	78"
72	72"	84"

SIZE NO.	A	B	C	D	E	F	G	H
DIAMETER INSIDE	16"	21"	27"	30"	40"	51"	60"	73"
DIAMETER OUTSIDE	25"	30"	36"	39"	49"	60"	69"	82"

NO. OF BLOCK	DIAMETER INSIDE	DIAMETER OUTSIDE
48	48"	66"
54	54"	72"
60	60"	78"
66	66"	84"
72	72"	90"
78	78"	96"
90	90"	108"
102	102"	120"

CALORIFIC VALUES OF VARIOUS OILS

Baume°	Specific Gravity	Pounds in a Gallon	Calculated B T U per Pound	Calculated B T U per Gallon	Remarks
14	9722	8 10	18810	152361	Mexico, California, Texas and Kansas Crudes Fuel Oil
15	9655	8 05	18850	151743	
16	9589	7 99	18890	150931	
17	9523	7 94	18930	150304	
18	9459	7.88	18970	149474	
19	9393	7 83	19010	148848	
20	9333	7 78	19050	148209	
21	9271	7 73	19090	147598	
22	9210	7 68	19130	146918	
23	9150	7 63	19170	146287	
24	9090	7 58	19210	145612	
25	9032	7.54	19250	145145	
26	8974	7 49	19290	144492	
27	8917	7 44	19330	143815	
28	8860	7 39	19370	143144	Kansas, Indian Territory and Illinois Crudes, Penn'a Fuel, California Refined Fuel Oil
29	8805	7 34	19410	142469	
30	8750	7.29	19450	141790	
31	8695	7 25	19490	141305	
32	8641	7 21	19530	140811	
33	8586	7 16	19570	140181	
34	8532	7 12	19610	139623	
35	8484	7.07	19650	138960	
36	8433	7.03	19690	138421	
37	8383	6.99	19730	137913	Ohio, Penn'a and West Virginia Crude California and Kansas Refined
38	8333	6.95	19770	137408	
39	8284	6.91	19810	136887	
40	8235	6.87	19850	136370	
41	8187	6.83	19890	135849	
42	8139	6 80	19930	135584	
43	8092	6.76	19970	134997	
44	8045	6 72	20010	134467	
45	8000	6 68	20050	133934	
46	7954	6.64	20090	133398	Kerosene and Gasoline
47	7909	6 60	20130	132858	
48	7865	6 57	20170	132517	
49	7821	6.53	20210	131971	
50	7777	6 49	20250	131423	

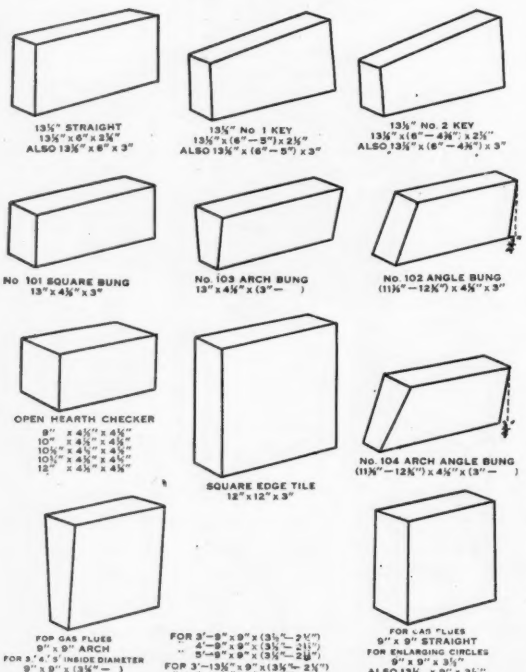
—Tate-Jones & Co.

TABLE II. PHYSICAL PROPERTIES OF BEARING METALS

Deformation of Cylinder 1¼ in. dia., 2½ in. high at 70 deg. F.

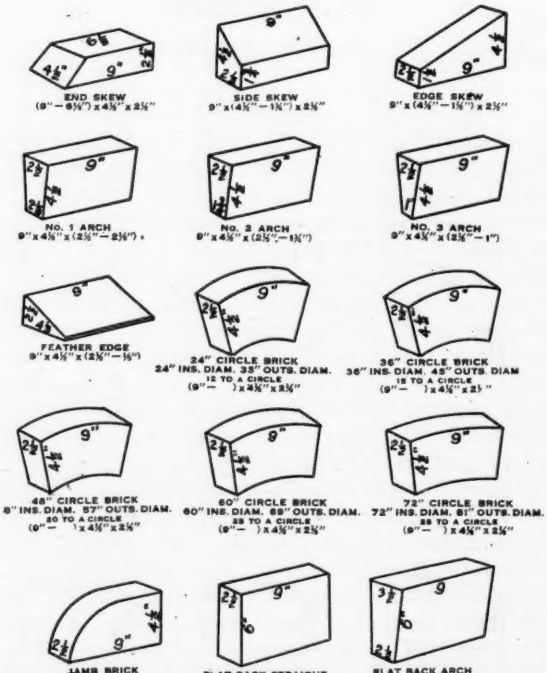
No. of Metal	At 1000 lb.	At 5000 lb.	At 10,000 lb.	Melting Point Degrees Fahr. Cent.
1	0.0000	0.0010	0.0150	453.2 234
2	0.0000	0.0015	0.0120	460.4 238
3	0.0010	0.0045	0.0070	462.2 239
4	0.0005	0.0025	0.0090	365.0 185
5	0.0010	0.0030	0.0090	----- ---
6	0.0015	0.0060	0.0180	----- ---
7	0.0010	0.0050	0.0230	464.0 240
8	0.0020	0.0090	0.0650	469.4 243
9	0.0040	0.0120	0.0840	469.4 243
10	0.0010	0.0100	0.1540	471.2 244
11	0.0010	0.0100	0.1190	474.8 246
12	0.0025	0.0170	0.2850	474.8 246

STANDARD FIRE BRICK


13½" STRAIGHT
13½" x 6" x 3"
ALSO 13½" x 6" x 3"
13½" No. 1 KEY
13½" x (6" — 5") x 2½"
ALSO 13½" x (6" — 5") x 3"
13½" No. 2 KEY
13½" x (6" — 4½") x 2½"
ALSO 13½" x (6" — 4½") x 3"
No. 101 SQUARE BUNG
13" x 4½" x 3"
No. 103 ARCH BUNG
13" x 4½" x (3" —)
No. 102 ANGLE BUNG
(11½" — 12½") x 4½" x 3"
OPEN HEARTH CHECKER
8" x 4½" x 4½"
10" x 4½" x 4½"
10½" x 4½" x 4½"
10½" x 4½" x 4½"
12" x 4½" x 4½"
SQUARE EDGE TILE
12" x 12" x 3"
No. 104 ARCH ANGLE BUNG
(11½" — 12½") x 4½" x (3" —)
FOR GAS FLUES
9" x 9" ARCH
FOR 3'-6" & 5' INSIDE DIAMETER
9" x 9" x (3½" —)
ALSO 13½" x 9" x (3½" —)
FOR 3'—9" x 9" x (3½" — 2½")
4'—9" x 9" x (3½" — 2½")
5'—9" x 9" x (3½" — 2½")
FOR 3'—13½" x 9" x (3½" — 2½")
4'—13½" x 9" x (3½" — 2½")
5'—13½" x 9" x (3½" — 2½")
FOR GAS FLUES
9" x 9" STRAIGHT
FOR ENLARGING CIRCLES
9" x 9" x 3½"
ALSO 13½ x 9" x 3½"

SUPERSEDING TABLES ON PAGES 863-864 OCT. 15, 1918

STANDARD FIRE BRICK


END SKEW
(9" — 6½") x 4½" x 2½"
SIDE SKEW
9" x (4½" — 1½") x 2½"
EDGE SKEW
9" x (4½" — 1½") x 2½"
NO. 1 ARCH
9" x 4½" x (2½" — 2½")
NO. 2 ARCH
9" x 4½" x (2½" — 1½")
NO. 3 ARCH
9" x 4½" x (2½" — 1")
FEATHER EDGE
9" x 4½" x (2½" — ½")
24" CIRCLE BRICK
24" INS. DIAM. 33" OUTS. DIAM.
12 TO A CIRCLE
(9" —) x 4½" x 2½"
36" CIRCLE BRICK
36" INS. DIAM. 45" OUTS. DIAM
18 TO A CIRCLE
(9" —) x 4½" x 2½"
48" CIRCLE BRICK
48" INS. DIAM. 57" OUTS. DIAM.
20 TO A CIRCLE
(9" —) x 4½" x 2½"
60" CIRCLE BRICK
60" INS. DIAM. 69" OUTS. DIAM.
22 TO A CIRCLE
(9" —) x 4½" x 2½"
72" CIRCLE BRICK
72" INS. DIAM. 81" OUTS. DIAM.
28 TO A CIRCLE
(9" —) x 4½" x 2½"
JAMB BRICK
9" x 4½" x 2½"
FLAT BACK STRAIGHT
9" x 6" x 2½"
FLAT BACK ARCH
9" x 6" x (3½" — 2½")

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able to market heretofore unused power, and the coal-burning companies were able to get power at a saving over their own costs.

Following are the companies cooperating in the joint operation plan: Adirondack Electric Power Corporation, Glens Falls, N. Y.; Cohoes Power Co., Cohoes, N. Y.; General Electric Co., Schenectady, N. Y.; Hudson Valley R. R. Co., Mechanicsville, N. Y.; Municipal Gas Co., Albany, N. Y.; Schenectady Power Co., Schaghticoke, N. Y.

Sometime ago the Fuel Administration, with the cooperation of the power companies, made a thorough investigation of power conditions in eastern New York. As a result of this investigation the power companies were asked to combine in a program of joint operation a plan made possible by connecting transmission lines already in existence, and the substitution of water for steam power. This was promptly agreed to, the available resources of the companies were placed in the hands of the joint committee and an operating department appointed to carry out the distribution of water power.

Using the existing equipment and organizations, and without additional labor cost, a two weeks' trial was commenced. At the end of that period, "there was such unanimity of thought, says the report to the Fuel Administration," that the question of continuing did not enter into the discussion of the joint committee, but simply the endeavor to secure the success of the scheme by agreeing to the costs of power sold by the hydro-electric companies to the coal-burning companies in place of burning coal.

Our Red Cross

SHALL WE leave our boys who have suffered in the trenches and battle-fields to the fate of cripples whom we sometimes see on our streets peddling pencils and shoestrings? Do we want men who have fought and been wounded that our country might be preserved to us to worry over what is to become of them and their families?

If we support the Red Cross, which is Uncle Sam's right arm in the work of reconstruction of disabled men, these things need not happen.

In New York, the Red Cross Institute for Crippled and Disabled Men is carrying on a demonstration school with six model courses; manufacture of artificial limbs, oxyacetylene welding, mechanical drafting, printing, motion picture operating and jewelry work. In the Walter Reed Hospital in Washington, men are being instructed in basketry, shorthand, motor repair, typewriting, rug weaving, carpentry and agriculture. Men are being taught and shown how they may be useful wage-earners, even though limbs have been lost. They are being encouraged to learn a new occupation, if necessary, or to learn the use of the left hand instead of the right, and to handle artificial limbs so as to "carry on" at the old trade.

This is a big work that our Red Cross is doing and for which it will be needed for a considerable time to come. Men must be refitted to take an active part in community life and to utilize so far as possible their ability gained from their former occupations. This will not militate against the pensioning of disabled men, but will be an added source of revenue to them to enable them to be better men, and live better.

And our work in France, Belgium, Italy and other European countries is not done yet. There are and will be for a long time hundreds of thousands of our soldiers "over there" who will need hospital care when sick or injured. The overseas Red Cross service does this, puts injured men in touch with their families, assists refugees to clothing, shelter and food, and will in future aid in re-establishing them in their homes, help to care for orphaned children, provide canteens at junction points where soldiers may get food, drink, tobacco, a bath and a place to wait between trains.

The Red Cross is carrying out the detail of the sending of Christmas packages to men across the sea. It is furnishing, as it has done, dressings for the wounded and injured, it is helping to keep convalescents cheerful so as to avoid the retarding effect of home-sickness. These and many other things must be carried on for a long time yet.

Here at home, we have had a demonstration of the effective work of this organization during the epidemic of Spanish influenza. Temporary hospitals were secured, nurses furnished, ambulances provided, medical aid procured. An appropriation of $575,000 was made for this work.

In the powder explosions and in the regions of forest fires, effective aid has been promptly rendered, both by sending of needed supplies and making funds available, and by the volunteering of thousands of women, who have been trained in Red Cross work, for emergency duty. The showing of efficiency and of patriotism have been such as to make us proud of our Red Cross.

To continue this work, the funds must be supplied, and this means that every man, woman and child in America should become a member. The call is to the heart of our great country, and the membership means only $1 for the year.

If you telephone your local Red Cross Christmas Roll Call Committee, they will provide the necessary subscription blanks; then do your best to see that every man and woman in the organization becomes a member. Make your plant and works a One Hundred Per Cent Plant. Turn over subscriptions and fees to your local Red Cross chapter. But Don't Wait. Act Now!

News Notes

I. H. MILLS, who has been associated with the Westinghouse Electric and Manufacturing Co., of East Pittsburgh, Pa., for the past 23 yr., has resigned to become superintendent of the Sperry Gyroscope Co., of Brooklyn, N. Y. Mr. Mills began his career with the Westinghouse as a machine operator, and finally became superintendent of the Small Industrial Motor Department.

THE FRANCE MANUFACTURING CO., of Cleveland, O., announces the appointment of Champion & Ryan, 299

Broadway, New York City, as its factory representatives in New York City, Boston, Philadelphia and adjacent territory.

THE CHICAGO PNEUMATIC TOOL CO. announces the appointment of L. C. Sprague as assistant secretary of the company with headquarters at 52 Vanderbilt Ave., New York City.

H. W. JOHNS-MANVILLE CO. announces, with deep sorrow, the death of Charles F. Simms, for many years manager of its Omaha office. Mr. Simms was associated with the company for nearly 30 yr. and played no small part in the development of its western enterprises. A man of sterling character, loyal, faithful and of pleasing personality, he enjoyed the love and respect of all who knew him and who now miss him keenly.

S. E. Cole, who has succeeded Mr. Simms in the management of the Omaha office, has been active in various fields of Johns-Manville endeavor and knows the Johns-Manville line in all its branches.

Catalog Notes

U. S. G. CO.'S Graphite Products General Catalog No. 20 has just been received from the United States Graphite Co., Saginaw, Mich.

DEARBORN CHEMICAL CO., of New York, is sending out its new calendar illustrated by views of the company's various laboratories and departments.

LINOTILE FLOORS for offices, churches, banks, theaters, stores, museums, libraries, kitchens, pantries, elevators, etc., are illustrated in a new pamphlet which also discusses the composition, qualities and care of Linotile. The manufacturer is Armstrong Cork & Insulation Co., Pittsburgh, Pa.

CATALOG R, lately published by Lagonda Mfg. Co., Springfield, Ohio, fully describes the Lagonda Multiple Filtration feedwater filter and grease extractor, illustrating by photographs of these grease extractors installed in various positions in power plants throughout the country.

Copies of the catalog will be sent on request.

PUBLICITY MAGAZINE, which has long been published by the Underfeed Stoker Co. of America to advertise the Jones Stoker, comes out for November under a new name, The Combustion Chamber. Besides enlarging on the good points of the Jones, it gives many helpful hints on boiler room operation. It is a readable little publication.

THE WORCESTER FOLDER has just been issued by The Davis Press, Worcester, Mass. This is one of a series of folders put out co-operatively by several Worcester manufacturers, including Graton & Knight Mfg. Co., to advertise their products and the city in which they are located. This number is printed in poster style from flat tint plates. The back page is a poster picture of Clara Barton, the founder of the Red Cross in America, who was a native of Worcester County, and the little footnotes on each page are quotations from soldiers' letters and various authorities about the Red Cross with the American army. It was felt by the manufacturers interested that they could thus make their advertising do its bit for this important organization, particularly as these were mailed during November and December to help along the Christmas Membership Campaign.

LATIN-AMERICAN concerns wishing to specify American structural steel for building and railway purposes can now do so without difficulty by referring to pamphlets in Spanish and English just issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce. These pamphlets are intended to facilitate sales of such materials in Latin countries, and are published in response to numerous requests from these countries.

The text defines with scientific accuracy the generally accepted American standards, as adopted by the American Society for Testing Materials.

The five pamphlets announced are Standard Specifications for Structural Steel for Buildings, Industrial Standards No. 8; for Locomotives, Industrial Standards No. 9; Carbon Steel Bars for Railway Springs, Industrial Standards No. 10; Quenched and Tempered Carbon-Steel Axles, Shafts and Other Forgings for Locomotives and Cars, Industrial Standards No. 12; Carbon Steel Forgings for Locomotives, Industrial Standards No. 13. These can be purchased at five cents a copy from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Trade Notes

PENBERTHY Injector Co., which started the manufacture of injectors in 1886 in a one-room plant with 144 sq. ft. of floor space, now occupies floor space of 2.5 acres. Recently, after 30 yr. of production, it turned out its one-millionth injector, which shows an average production of nearly 3000 injectors a month during that period; this product would feed 50,000,000 boiler horsepower.

ON AND AFTER Jan. 1, 1919, the Sanford Riley Stoker Co. and Murphy Iron Works will combine their sales policies so as to render the greatest possible service to all customers.

Offices will be located at: Worcester, Boston, New York, Philadelphia, Pittsburgh, Buffalo, Cleveland, Detroit, Cincinnati, Chicago and St. Paul.

Each office will handle both the sales and service for Riley Underfeed Stoker and the Murphy Automatic Furnace. Engineers at the various offices will not only help customers to select the equipment most suitable for their conditions or requirements, but will also be at their service at all times to show them how to get the most out of their present equipment.